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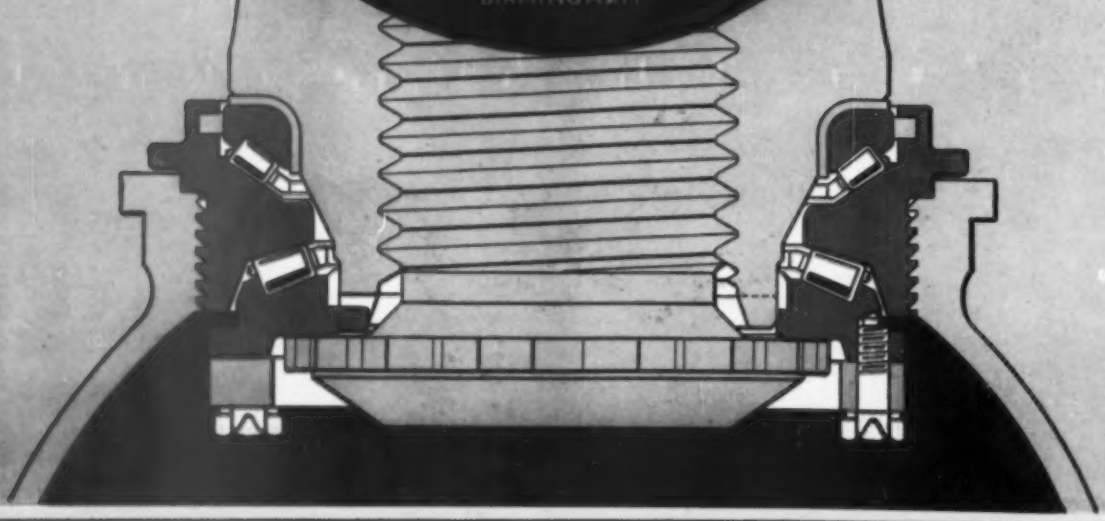

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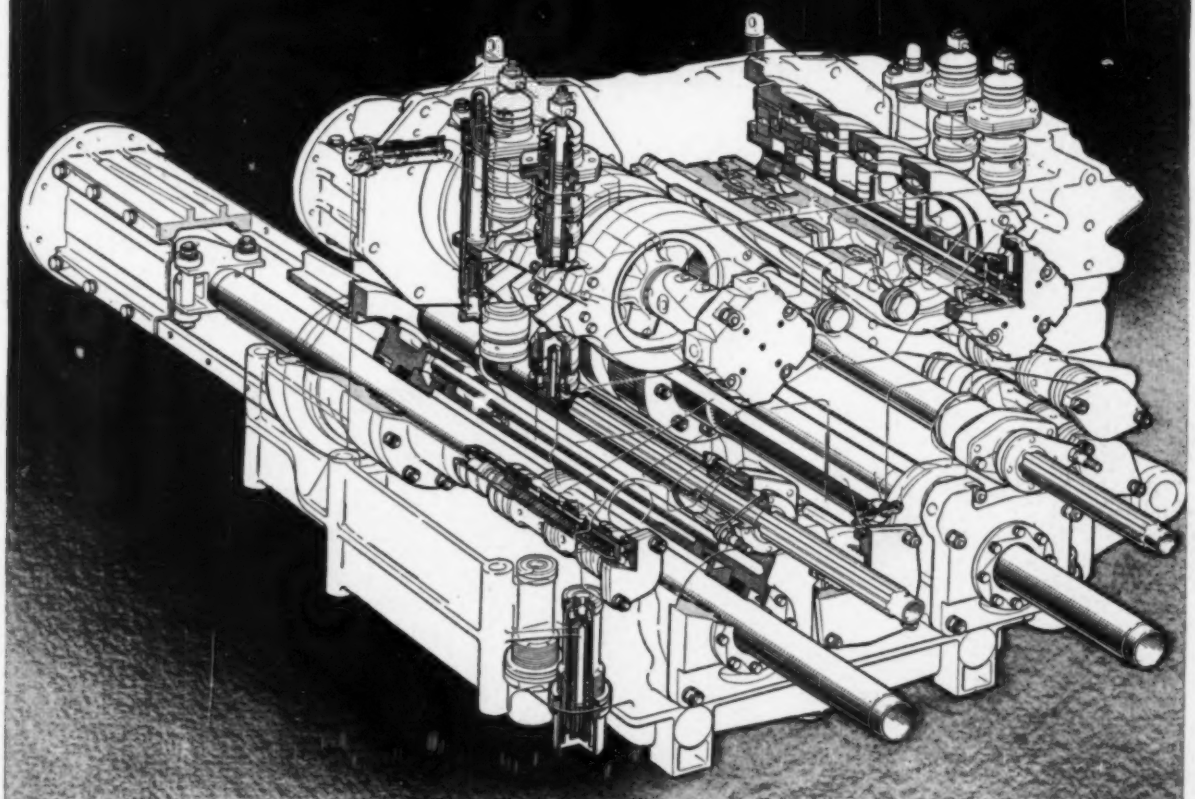

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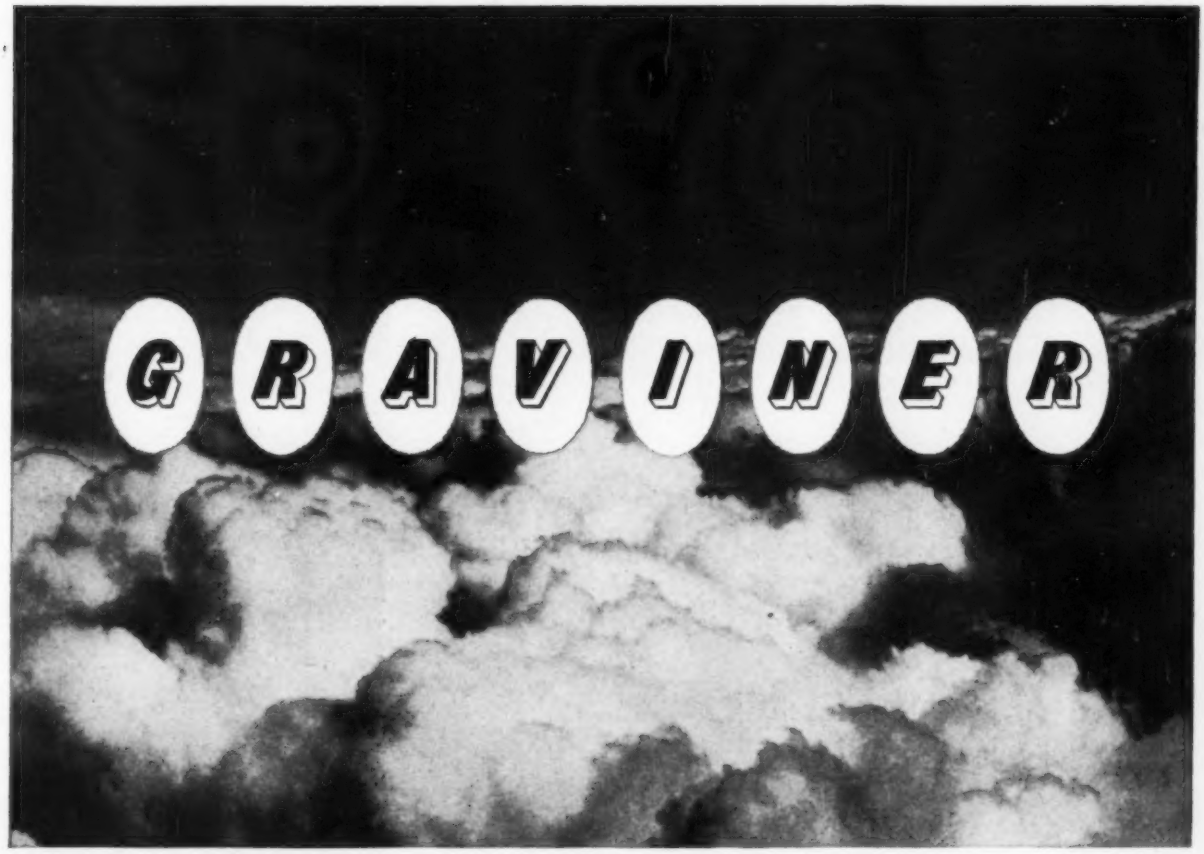

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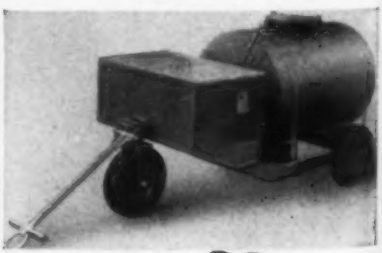

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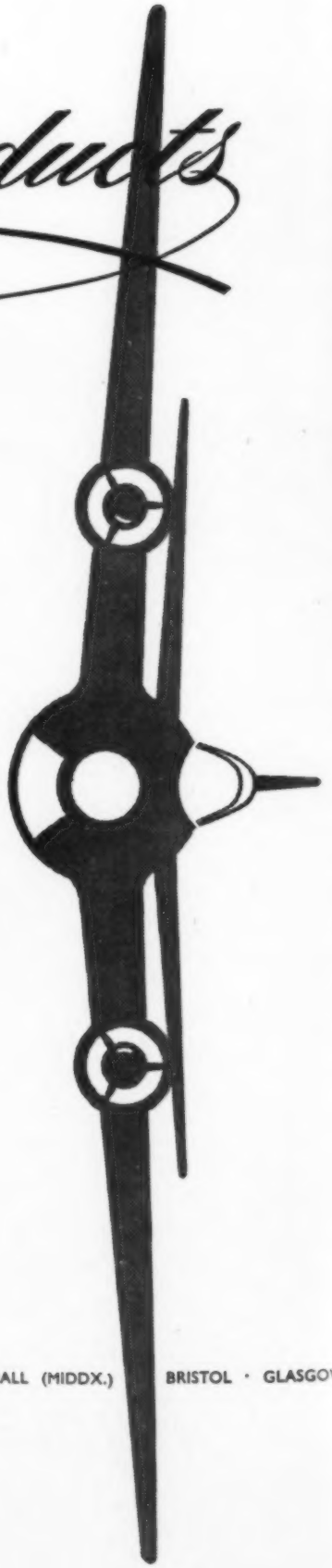

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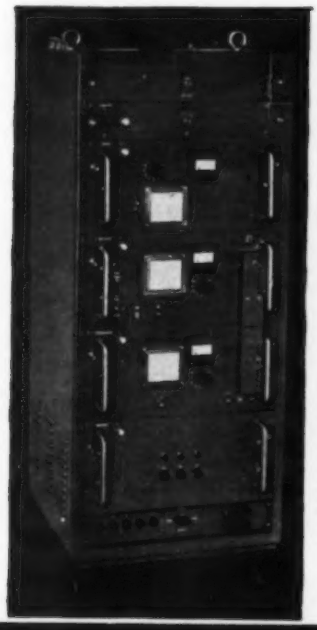
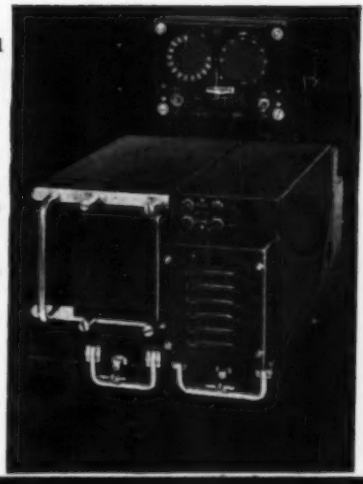


Multi-channel aeronautical ground station, MR 370

Covers frequency band, 100-156 Mc/s, and provides 622 channels, spaced 90 Kc/s or 560 spaced 100 Kc/s. Channel change time: under 5 sec. Control: direct, or remote over telephone line. Fits most types of control console and mounts in standard racks. Units slide out and turn 90° for easy servicing. Transmitter power: 50 watts. Receiver fitted with automatic gain control and noise limiting. Sensitivity: 1 microvolt opens squelch. Selectivity: 100 db down at 90 Kc/s. Spurious radiation: —90 db. Spurious responses: —90 db. Weight: 122·5 lb.



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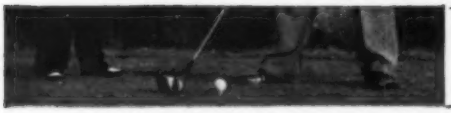

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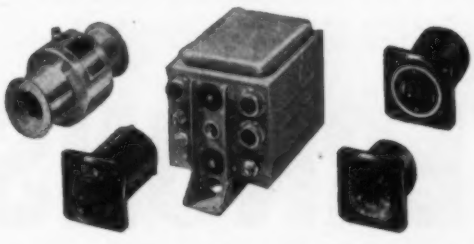

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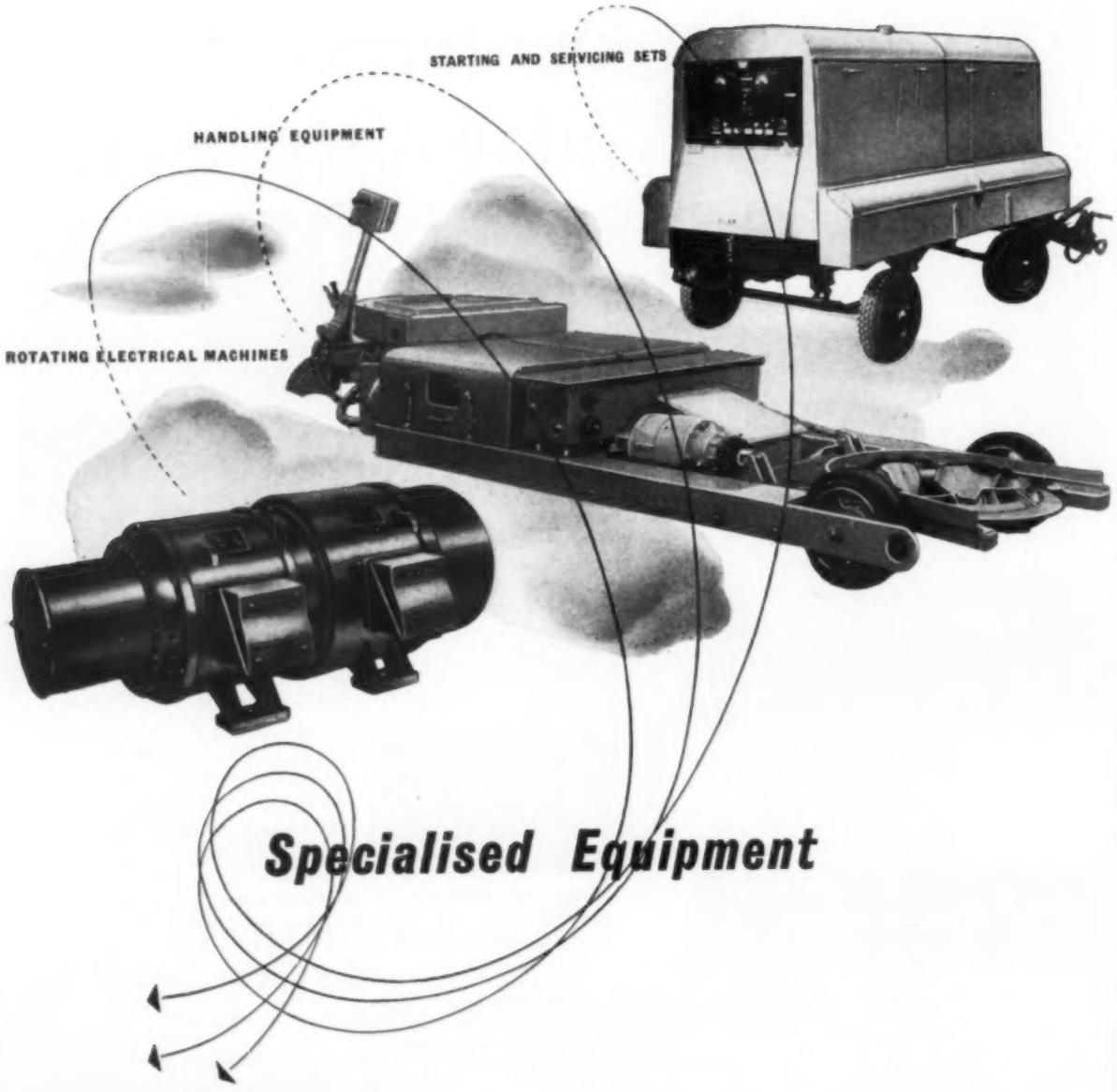

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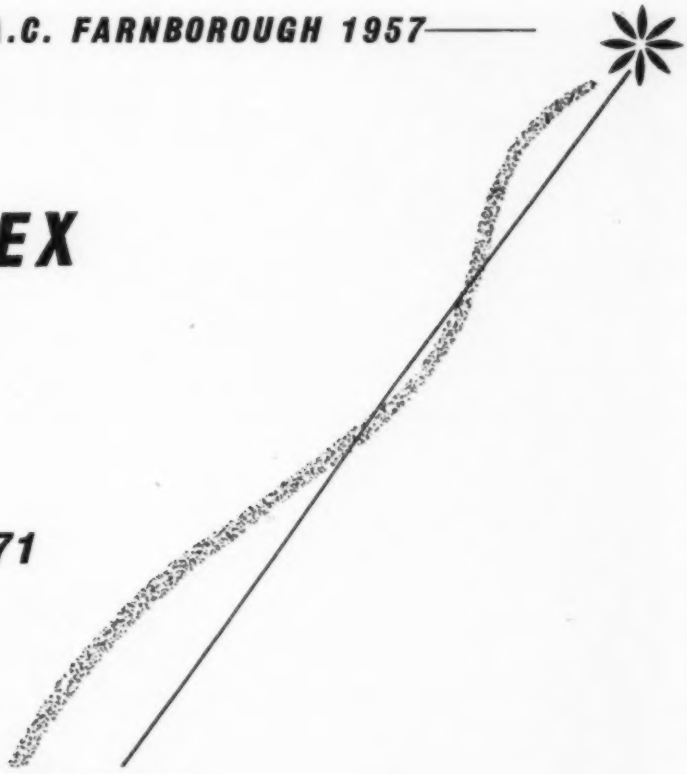

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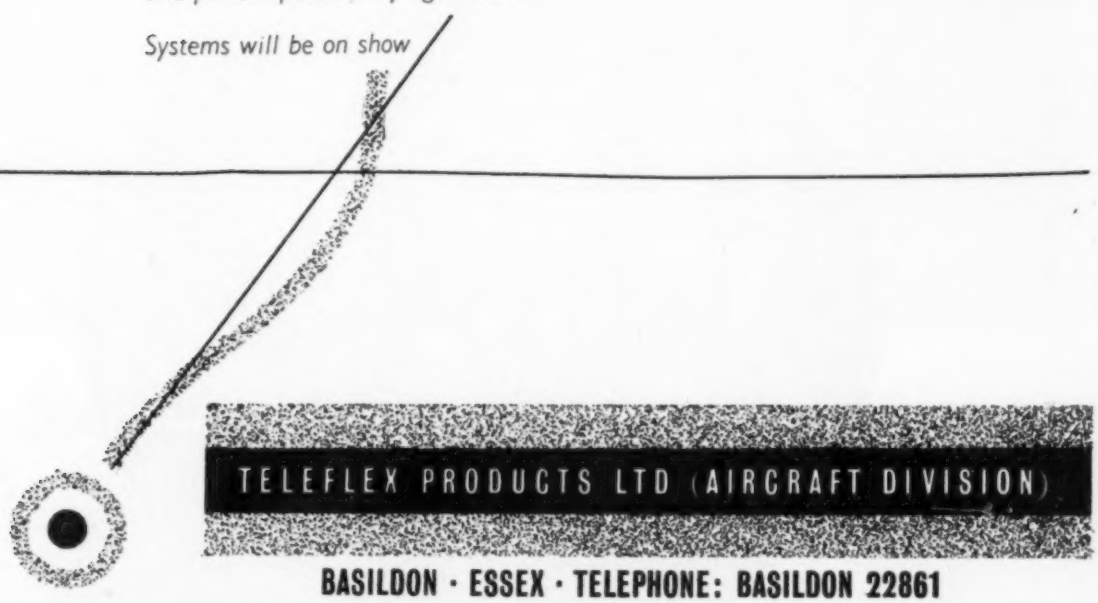

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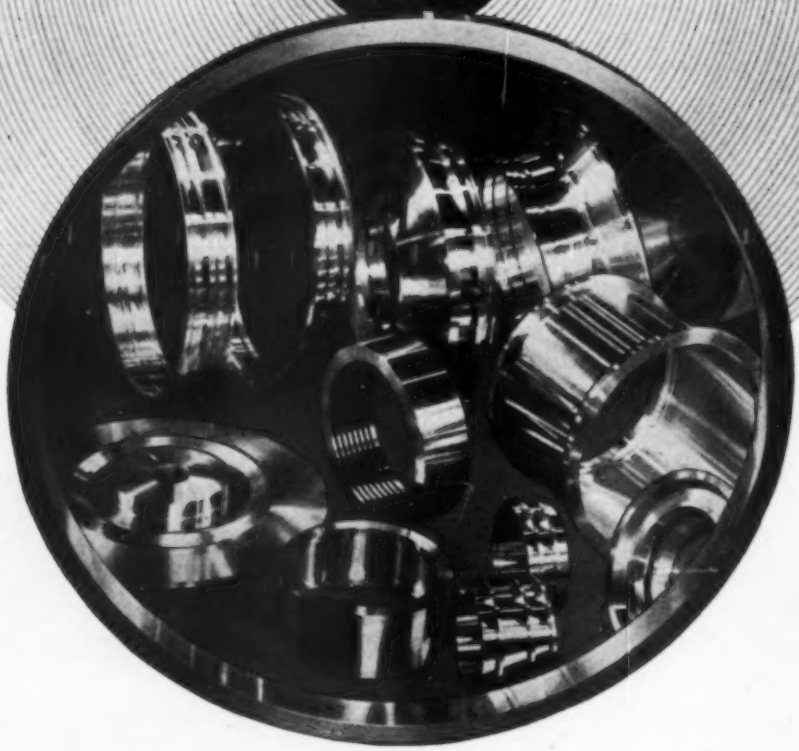

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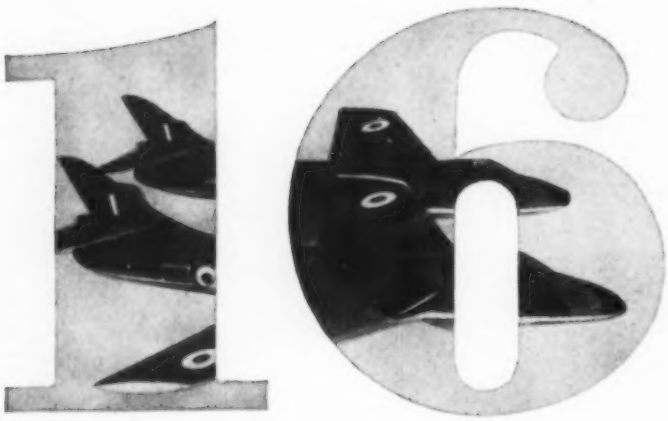

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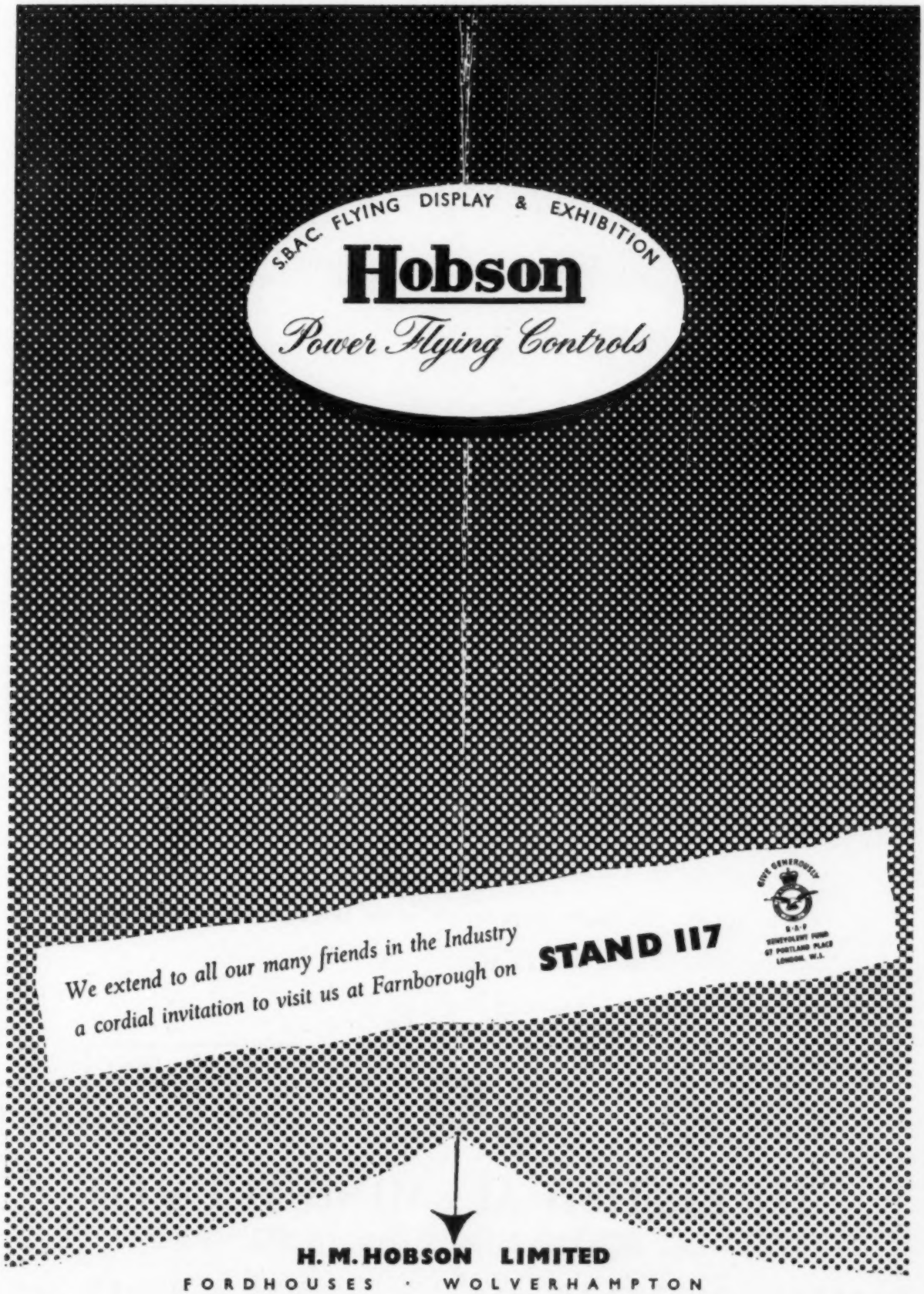
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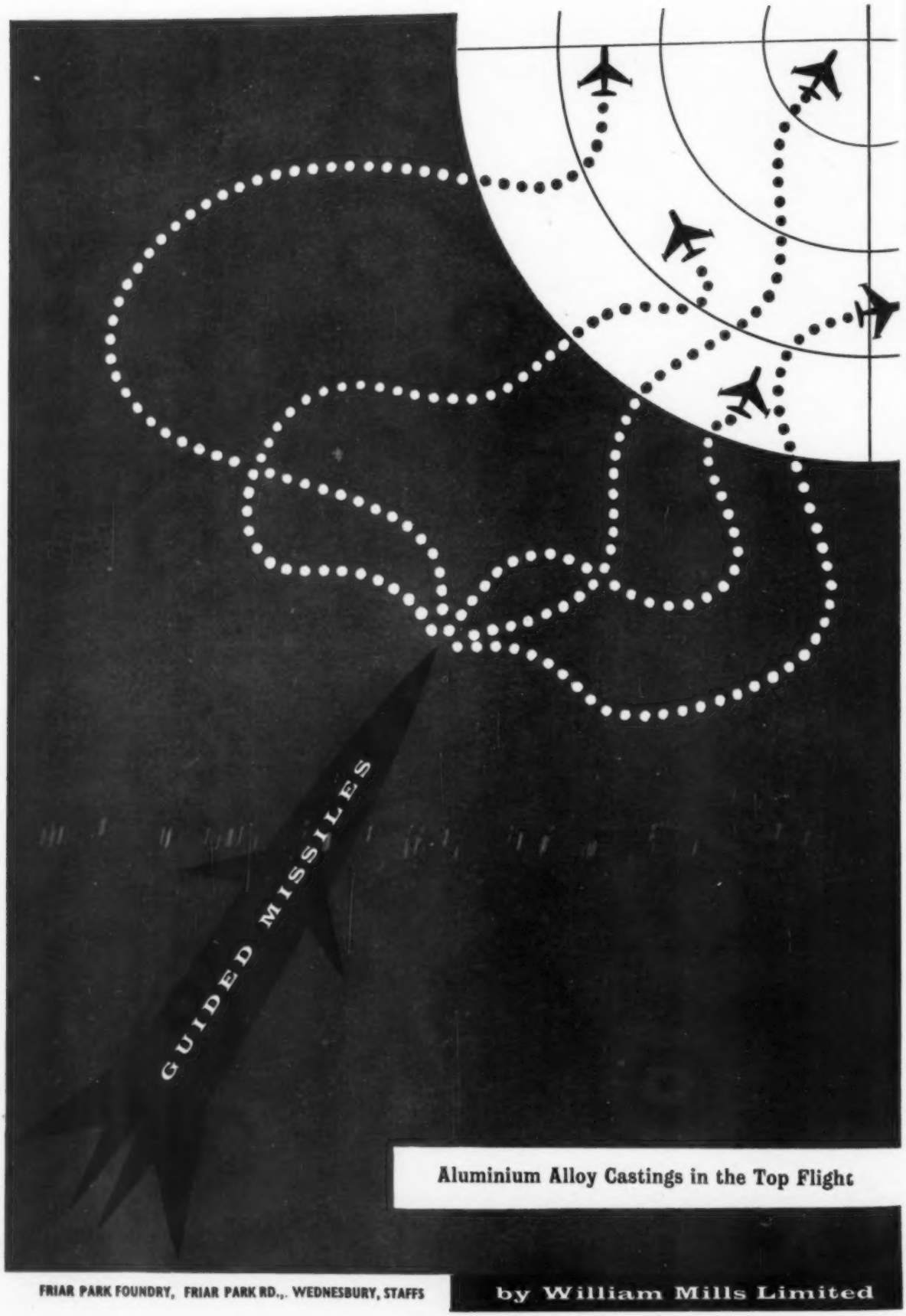

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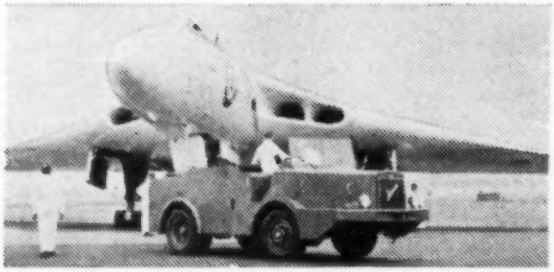

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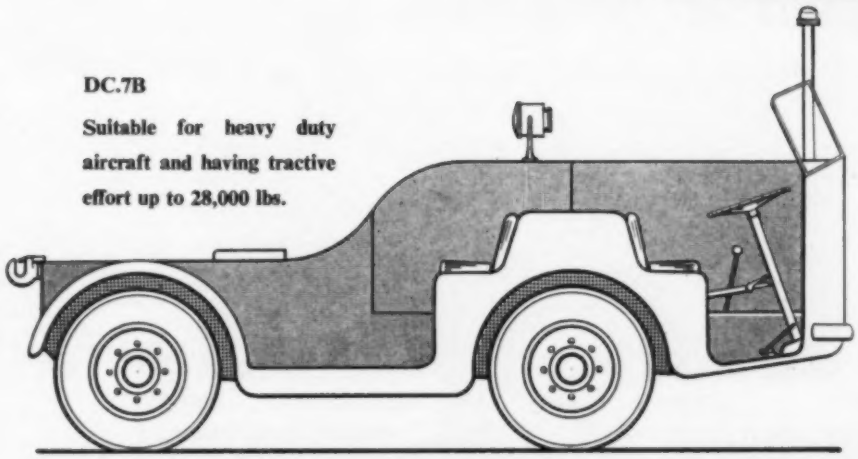

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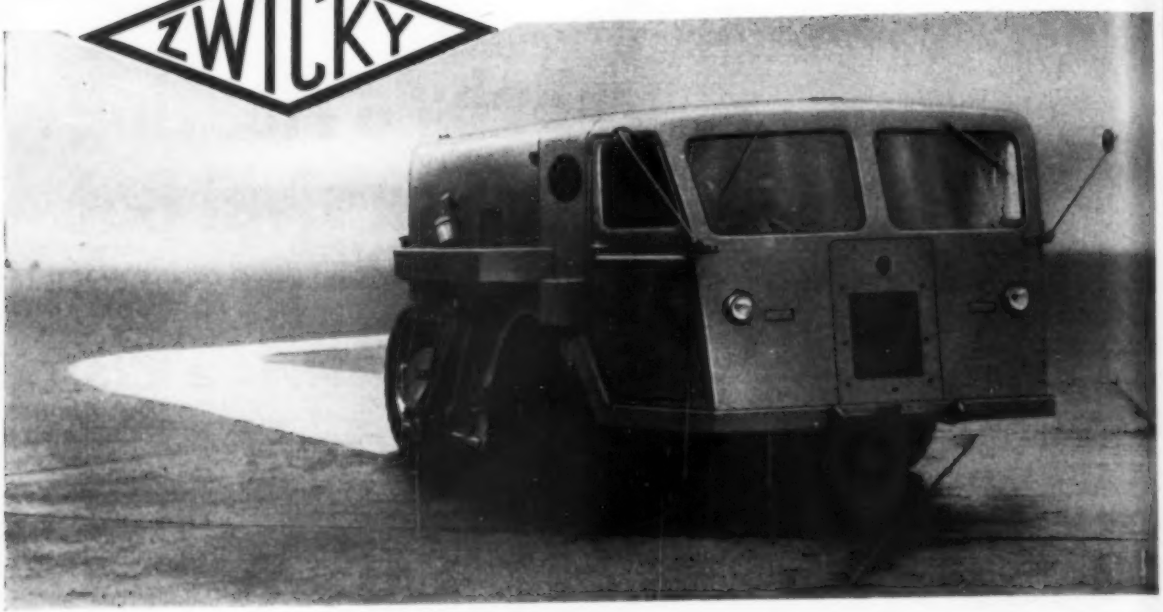

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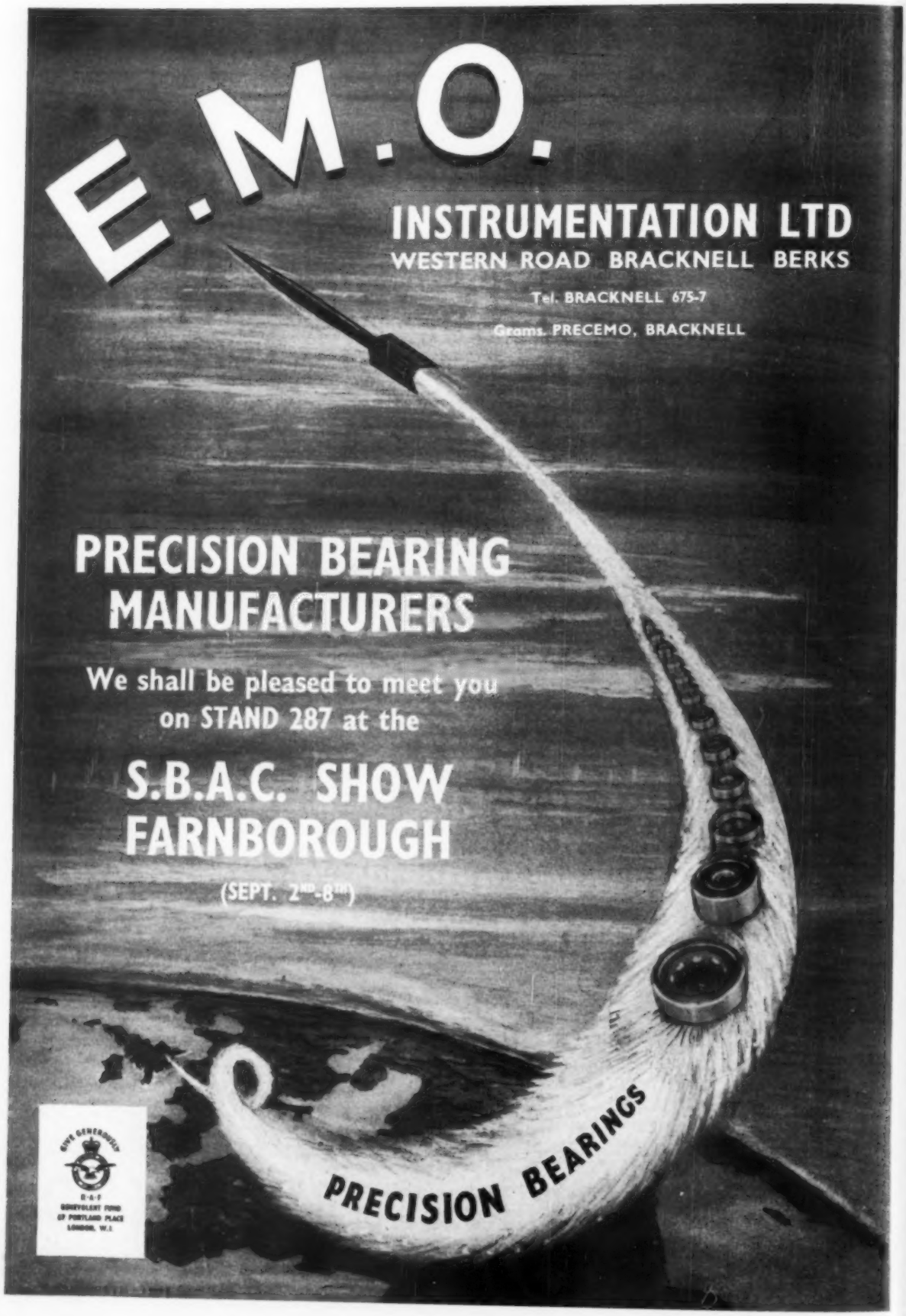
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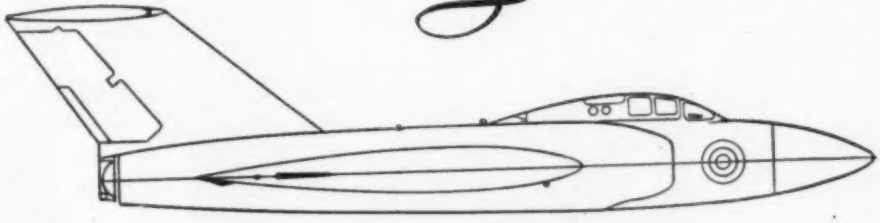

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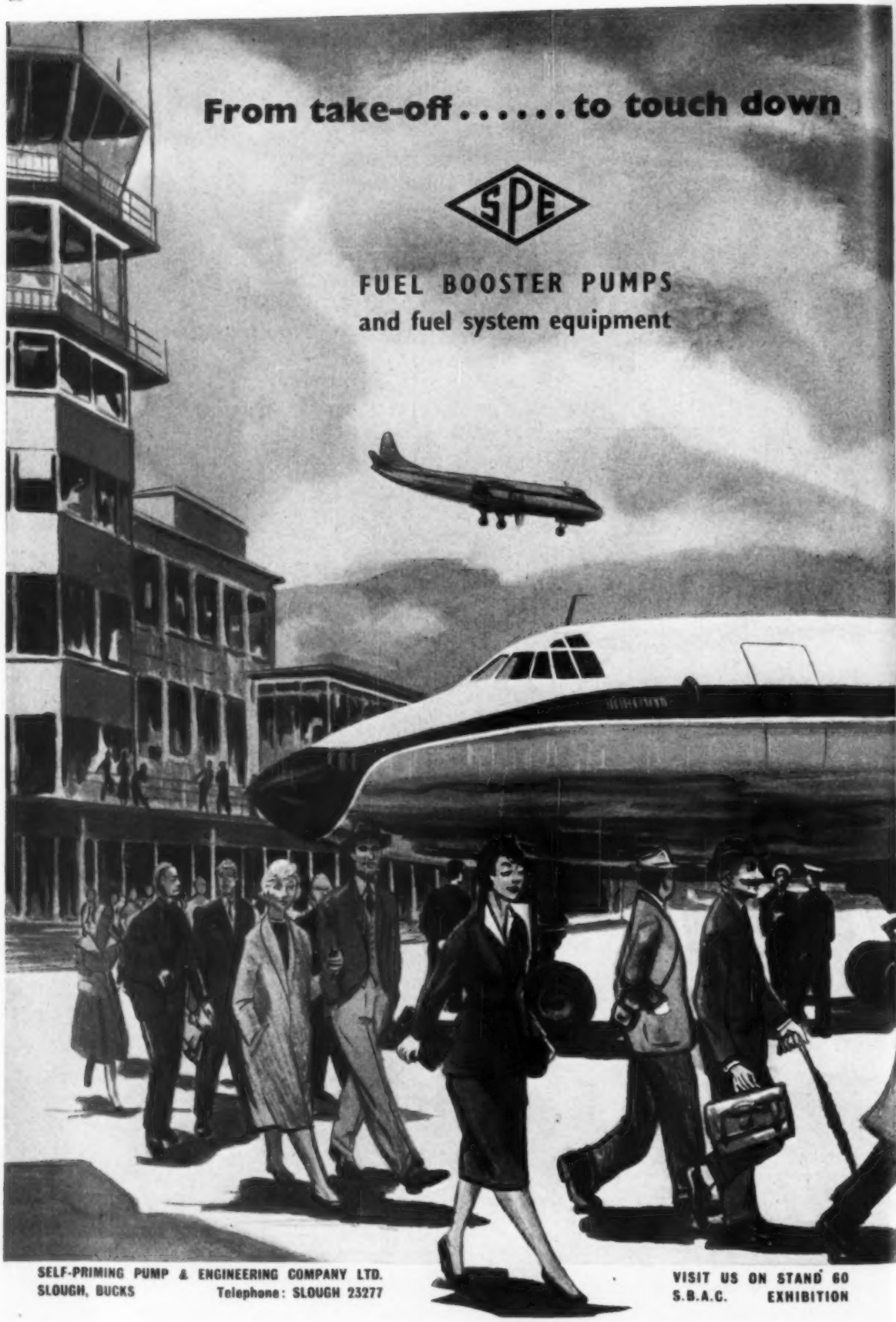
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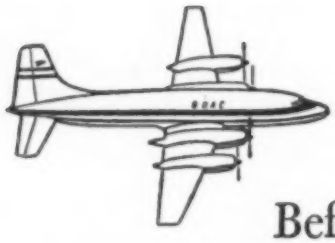

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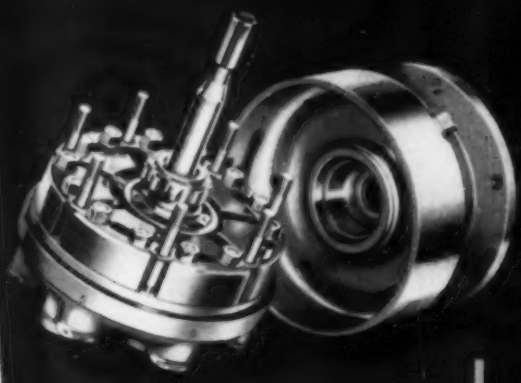

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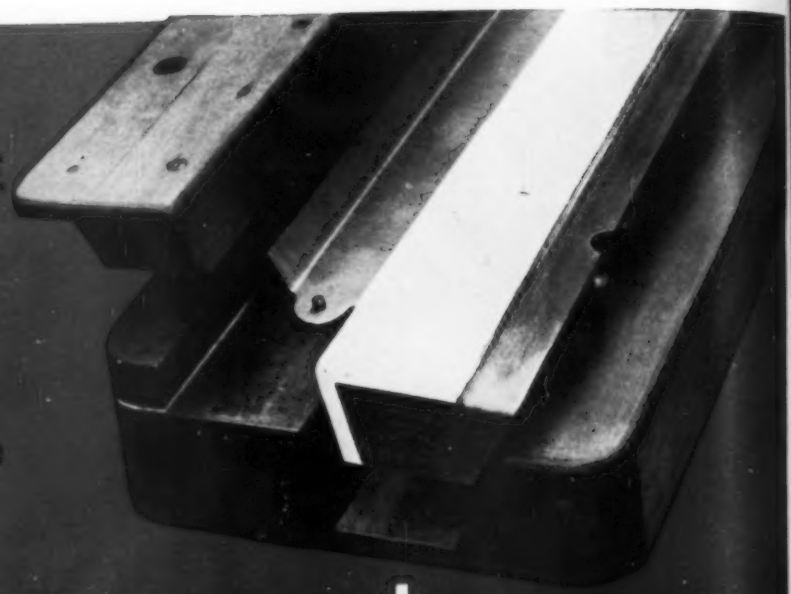

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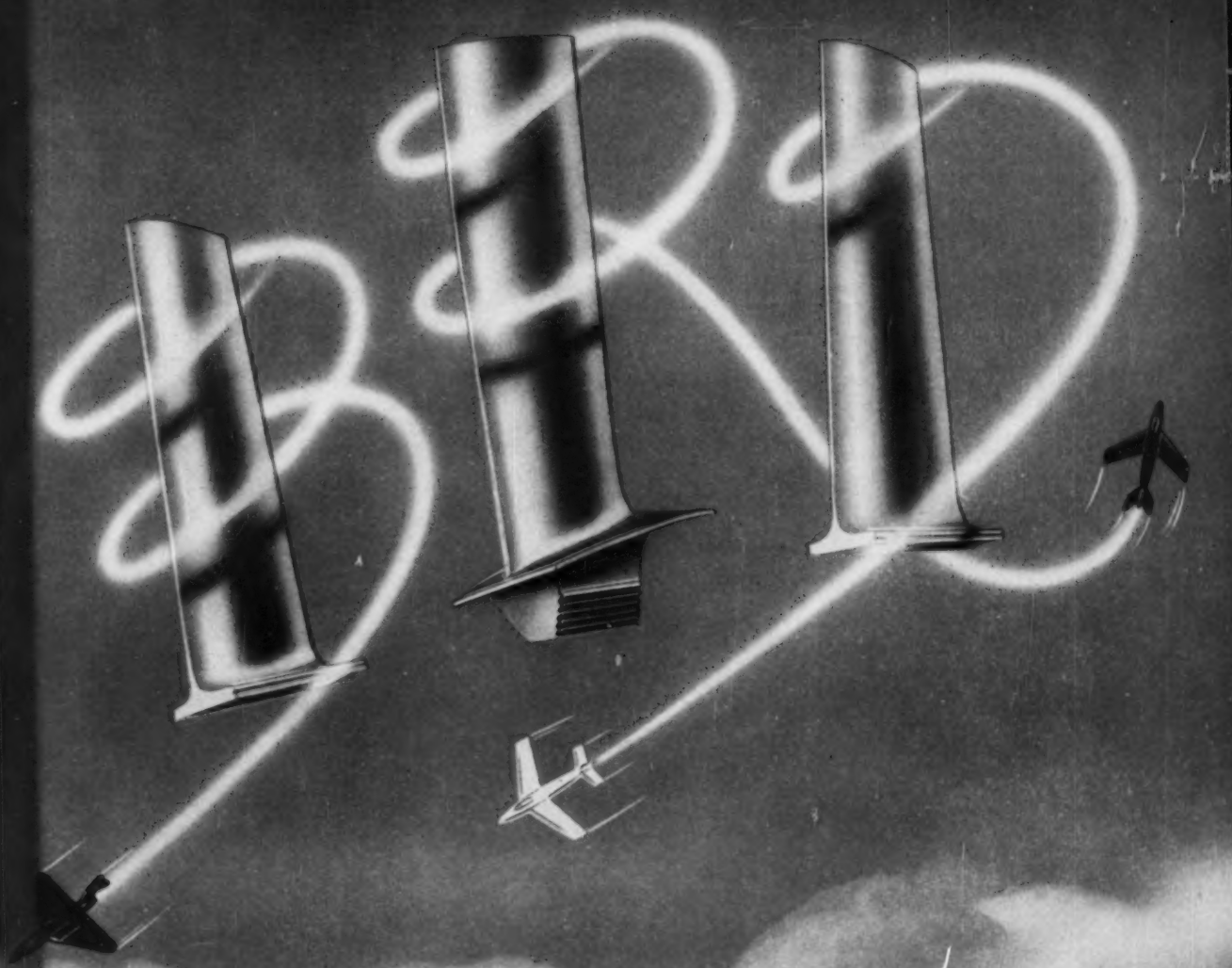

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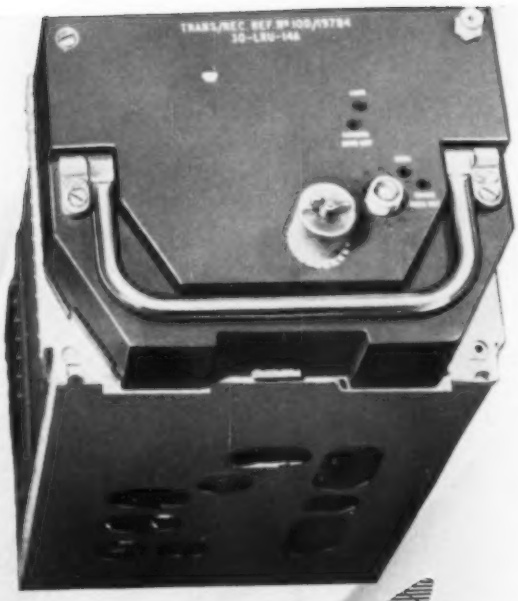

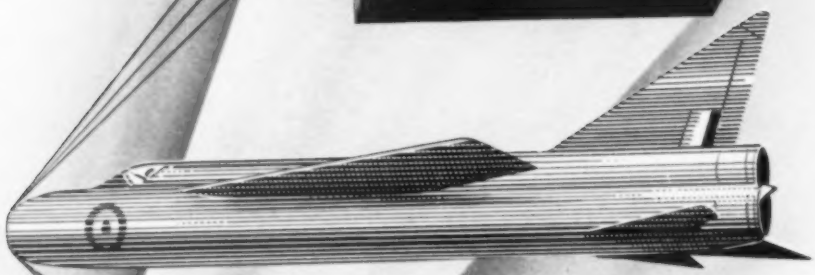

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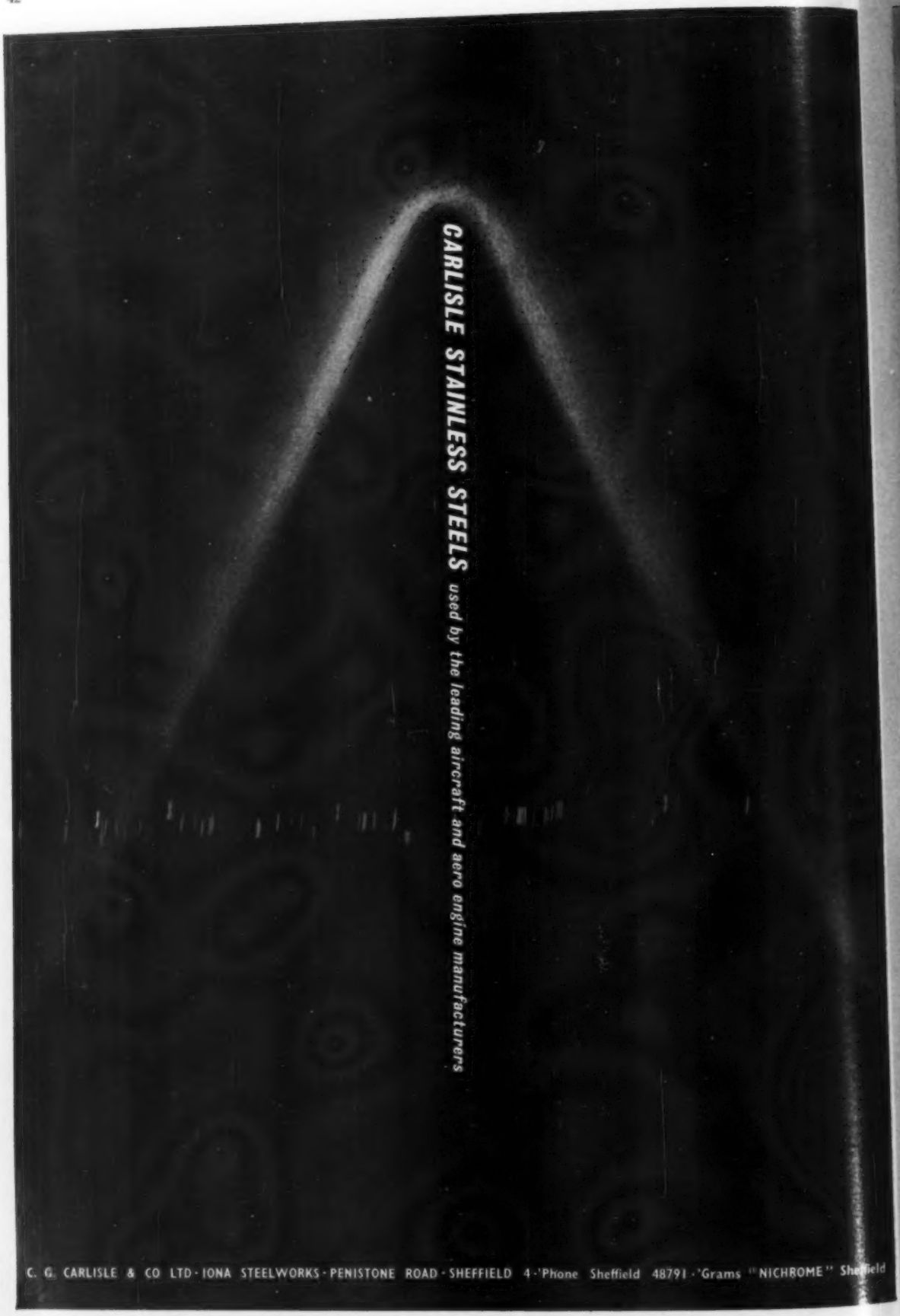
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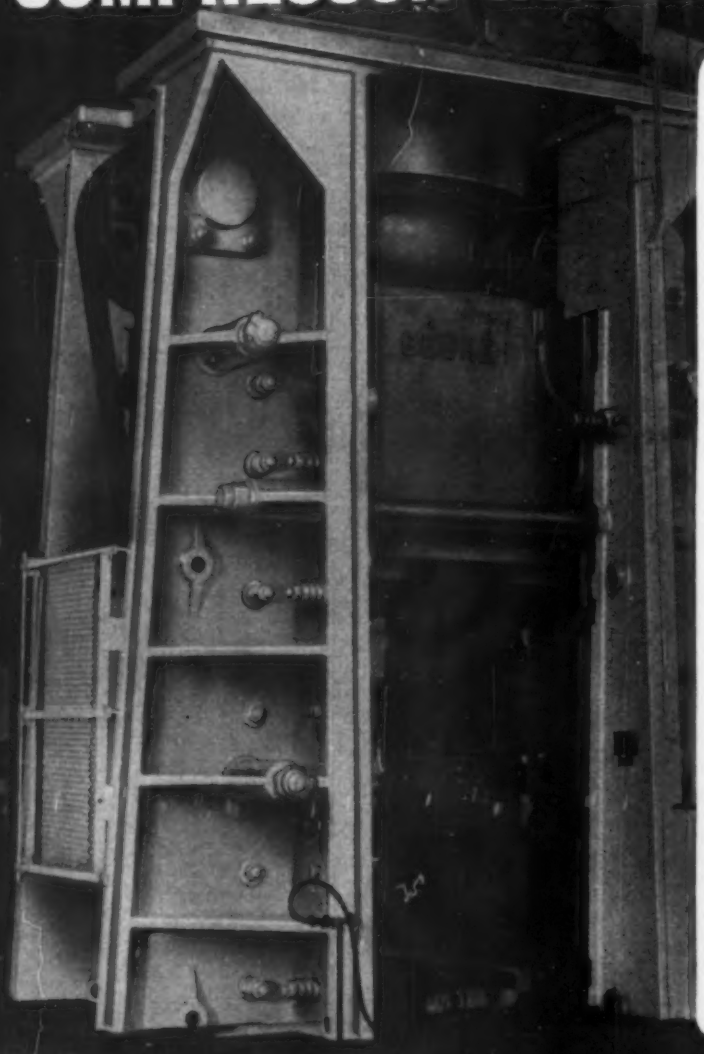

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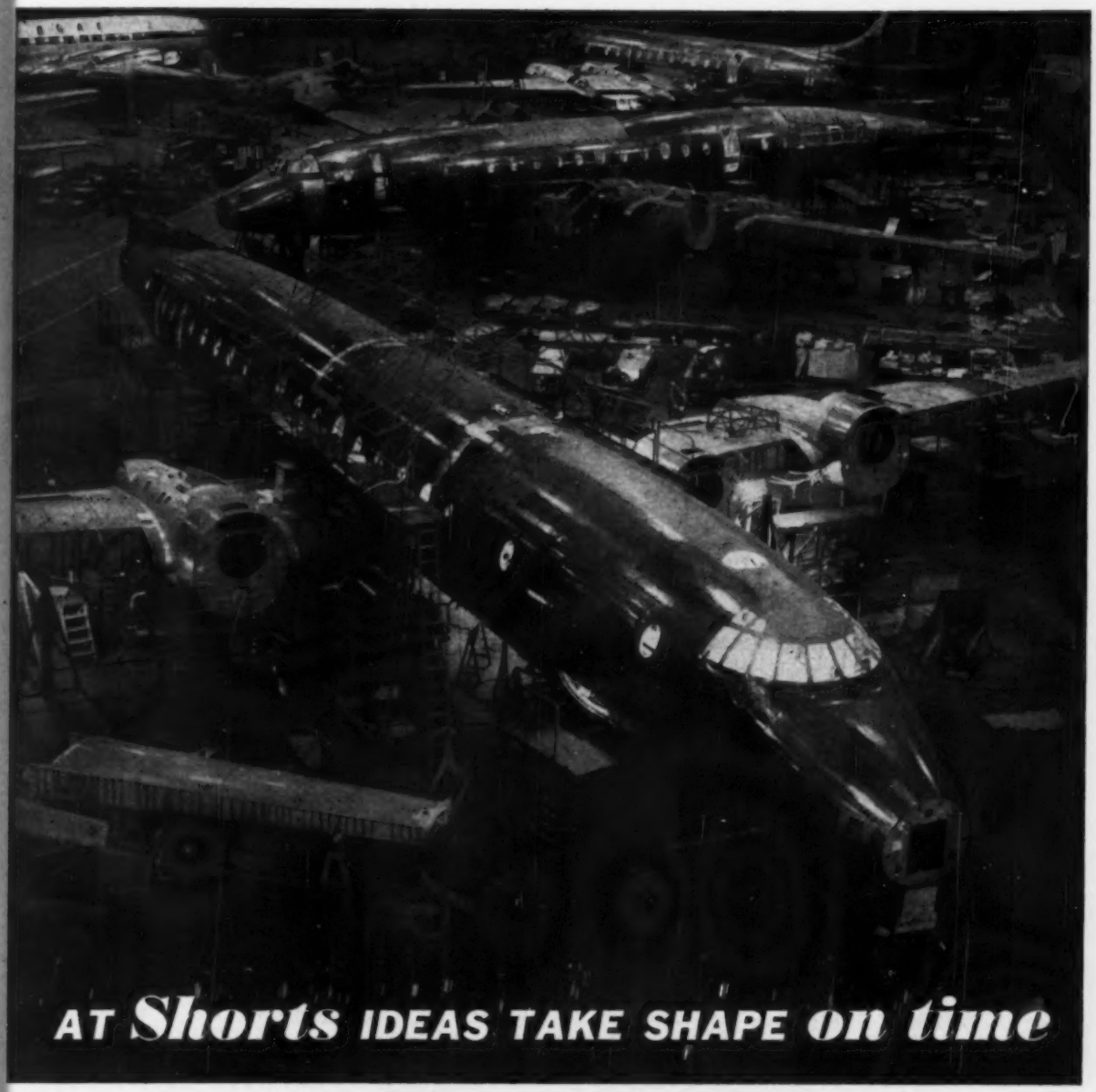

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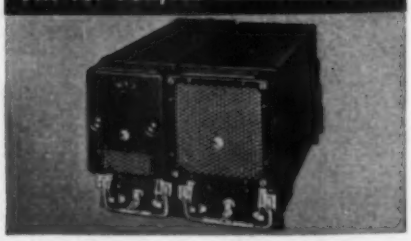

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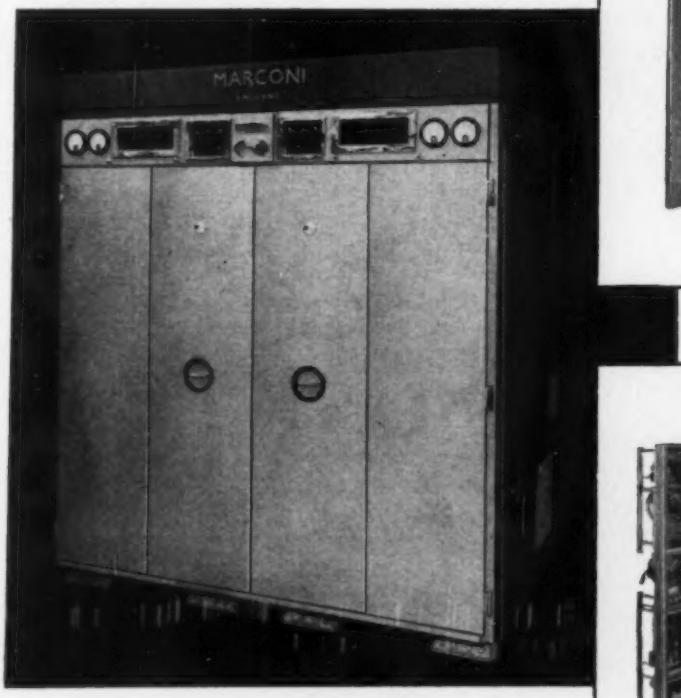

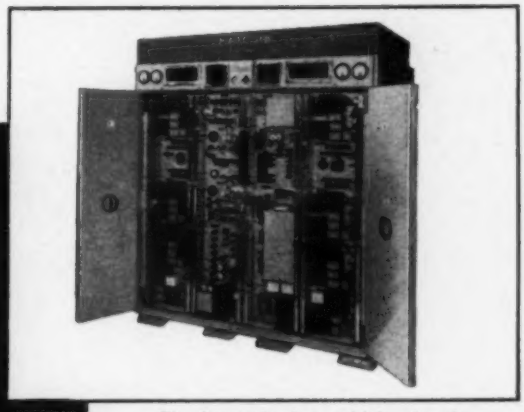

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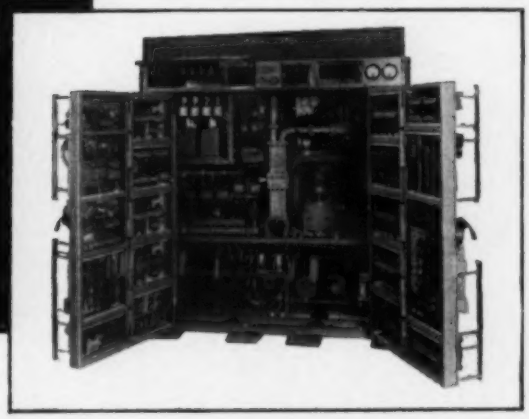

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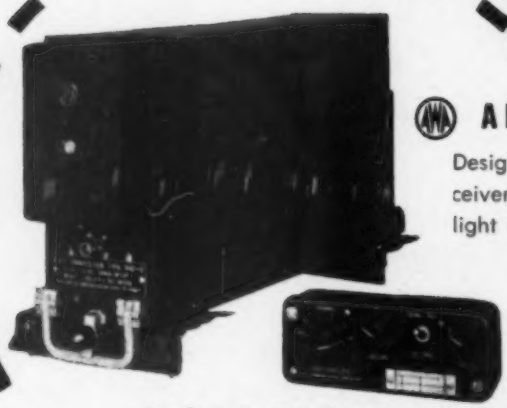

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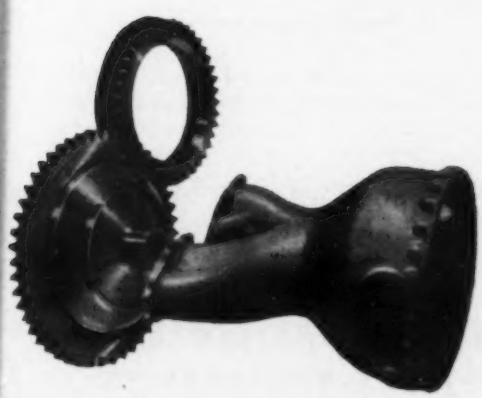

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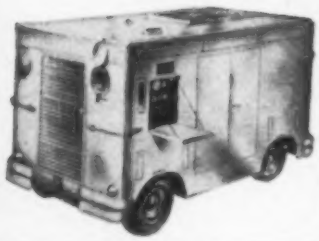

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Air flow ... ... 1750 cfm (50m³/min.)
Temperature drop ... ... 90°F (50°C)

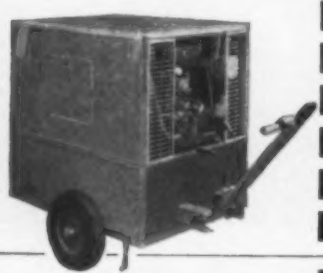
HEATING
Capacity ... 250,000 B.Th.U/hr. (minimum) (63,000 Kilo-cal/min.)

PRESSURE TESTING
Air flow (free air) ... ... 1250 cfm (35m³/min.)
Pressure ... up to 12 psi (g) (0·84 kg/cm²)

R.300 Mk. 1 Pressure Testing Trolley

PERFORMANCE*

Air flow ... ... 250 cfm (7·1m³/min.)
Pressure ... ... 10 psi (g) (0·7 kg/cm²)



VC-50 Mk. 1 Air Supply Trolley

PERFORMANCE*

Air flow ... ... 50 cfm (1·4m³/min.)
Pressure ... ... 10 psi (g) (0·7 kg/cm²)
Water content ... 0·0005 lb./cubic ft. (max.) (7·5 gm/m³ (max.))
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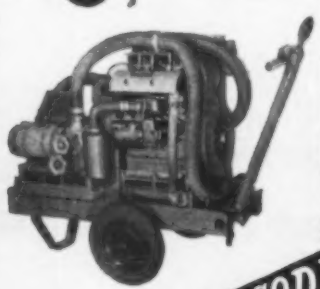

Mk. 1C Pressure Testing Trolley

PERFORMANCE*

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Pressure ... ... 10 psi (g) (0·7 kg/cm²)

* MEASURED AT TROLLEY OUTLETS

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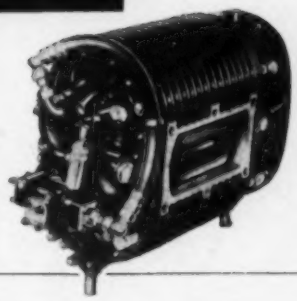
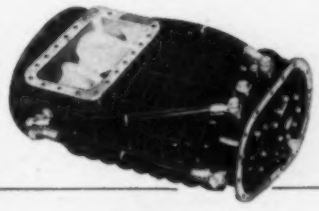
The Type 15 Cabin Supercharger has accumulated millions of flying hours of world wide operation in such notable aircraft as the Airspeed Ambassador, B.O.A.C. Argonaut, TCA North Star and Vickers Viscount. The supercharger is also installed in the Handley Page Herald and in both the Fokker and the Fairchild versions of the Friendship.

Cabin Superchargers



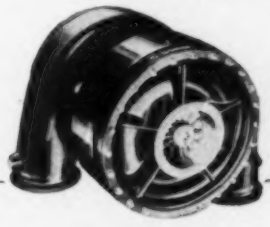
For aircraft requiring higher flows and pressure ratios for the cabin conditioning system, the Company has developed the Godfrey/SRM Screw Type Compressor. This unit is also a positive displacement type and is therefore surge free. It will operate at efficiencies comparable with those of the centrifugal compressor.

Godfrey/SRM Screw Type Compressors



Cold Air Units have been designed and manufactured by the Company for 10 years. These units are installed in all types of civil and military aircraft. The model illustrated — a CA-7 — is supplied for the Airspeed Ambassador, and all variants of the Vickers Viscount.

Cold Air Units



Godfrey Water Extractors are fitted in the air conditioning systems of a large number of civil and military aircraft. The type WE-120 illustrated here is installed in the Bristol Britannia.

Water Extractors

The Company is manufacturing an entirely new range of ***flow control valves, temperature control valves, shut-off valves*** and ***pressure ratio controllers.*** These valves are available in materials to suit high and medium temperature applications. ***Turbo alternators*** designed and developed by the Company are being manufactured for special duties including power supply for guided missiles.

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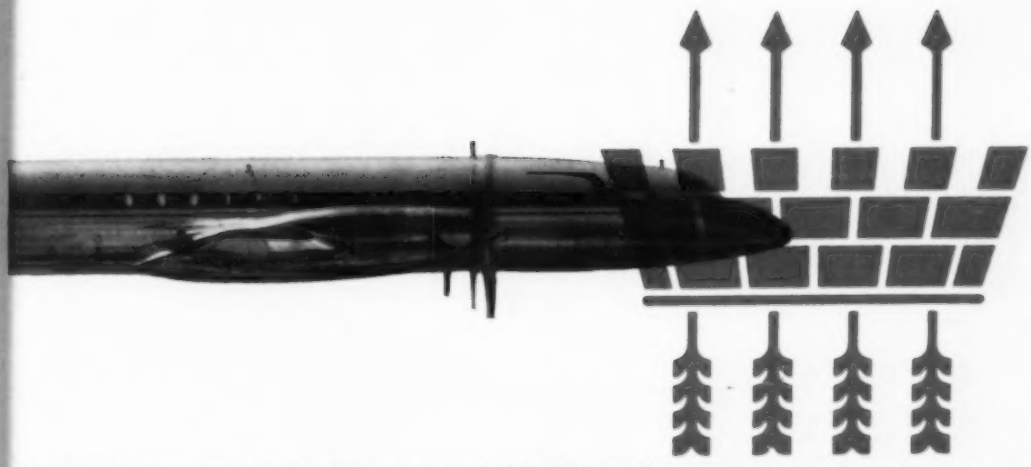

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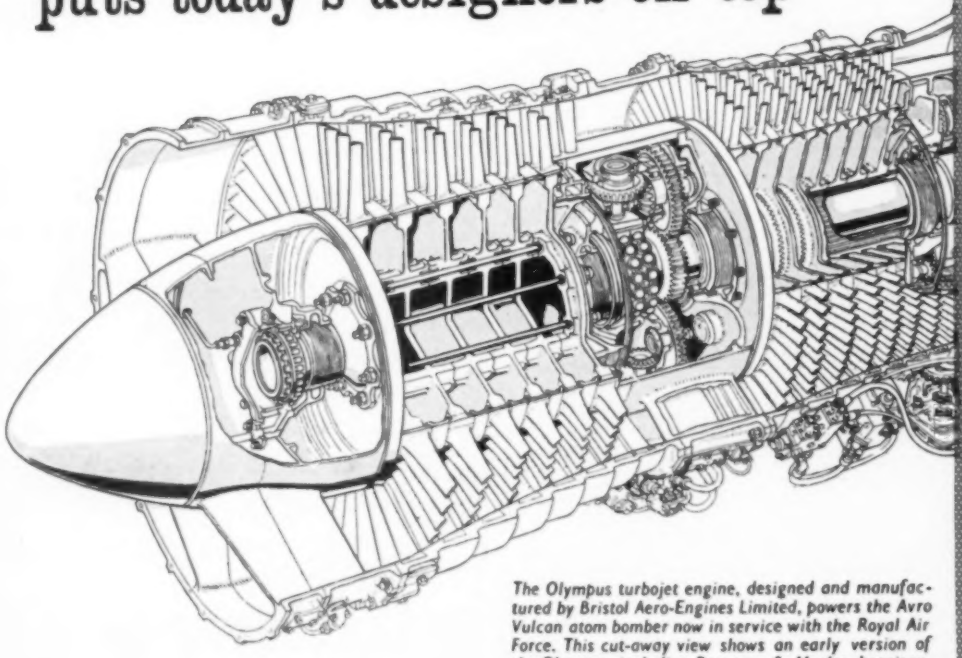

The Olympus turbojet engine, designed and manufactured by Bristol Aero-Engines Limited, powers the Avro Vulcan atom bomber now in service with the Royal Air Force. This cut-away view shows an early version of the Olympus, including Ransome & Marles bearings. Drawing by permission.

Drawing by "Flight."

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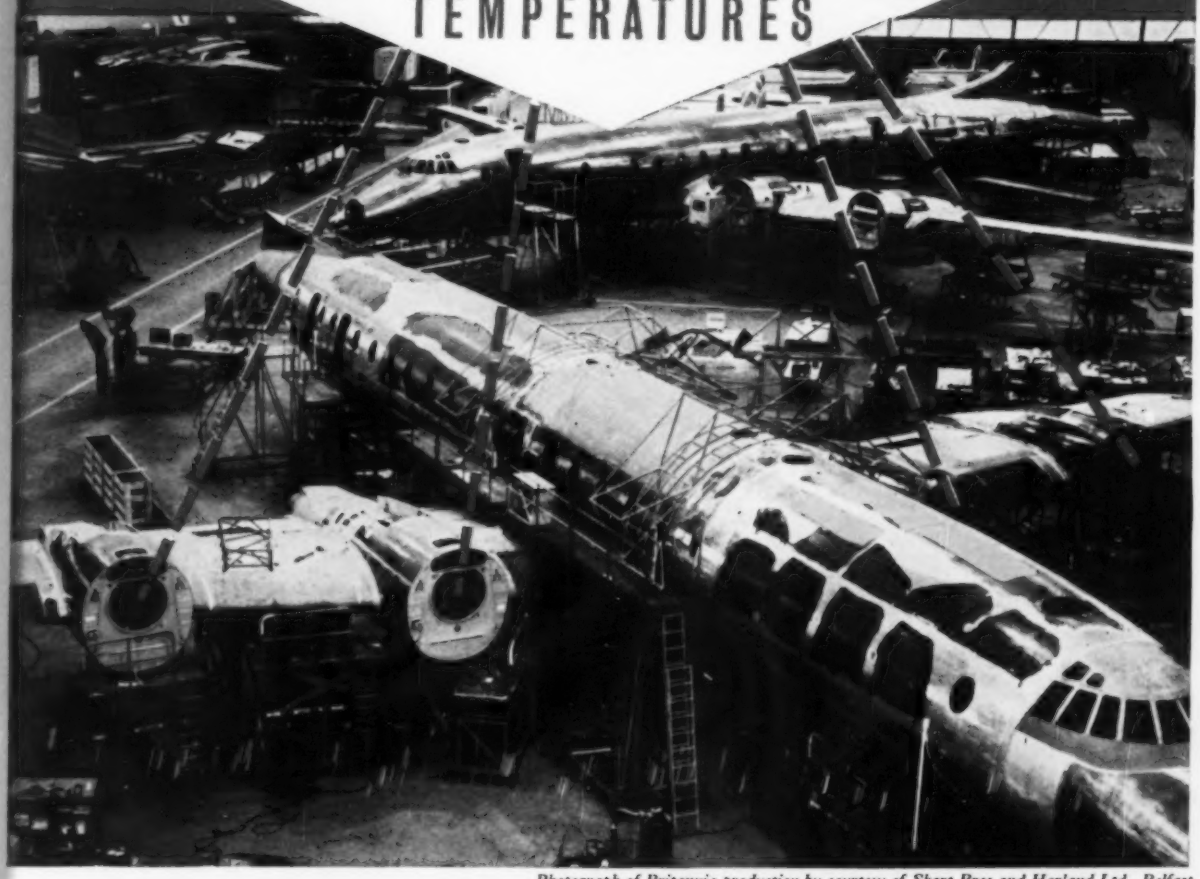

Photograph of Britannia production by courtesy of Short Bros and Harland Ltd., Belfast

Titanium and its alloys can not only withstand moderate temperatures — from 200°C up to 400°C — for prolonged periods, they can also resist higher temperatures for short periods.

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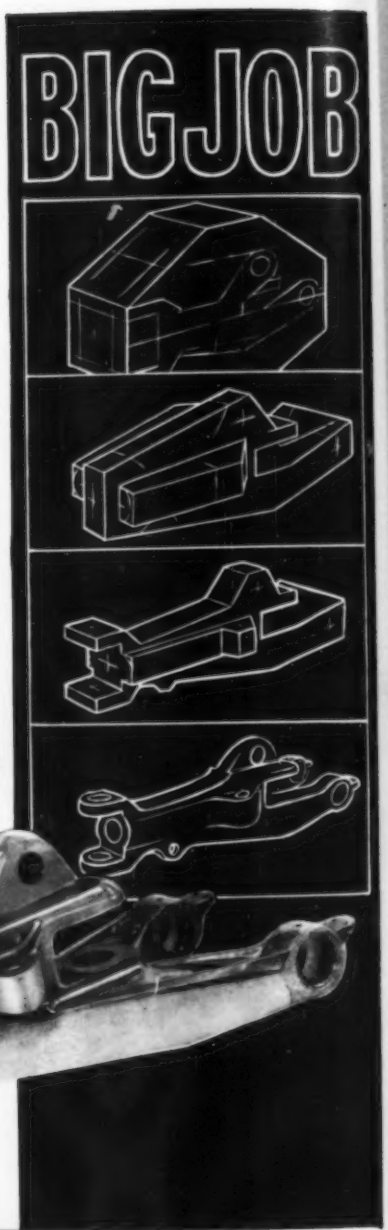

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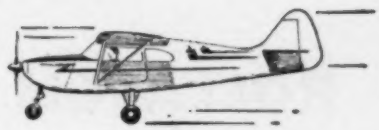

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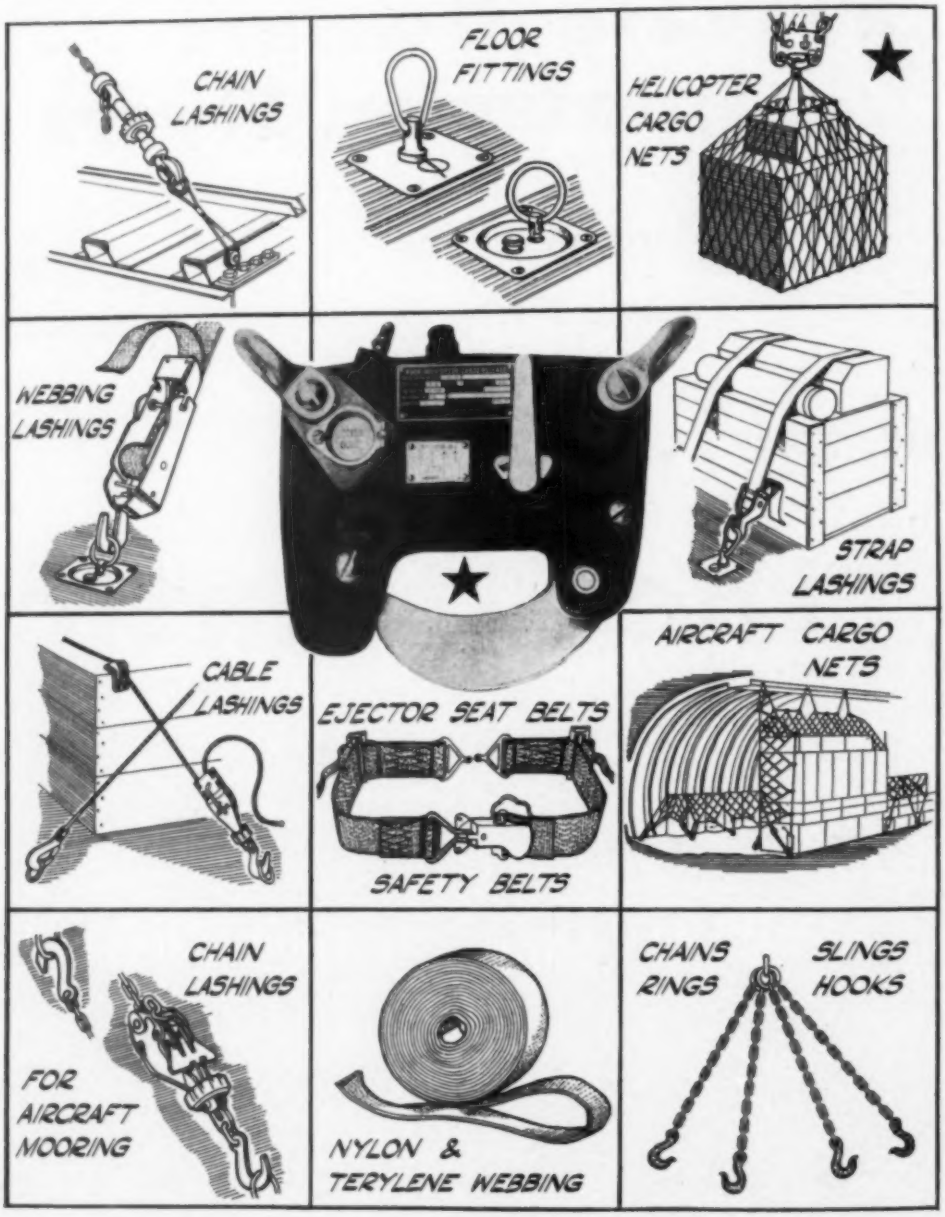

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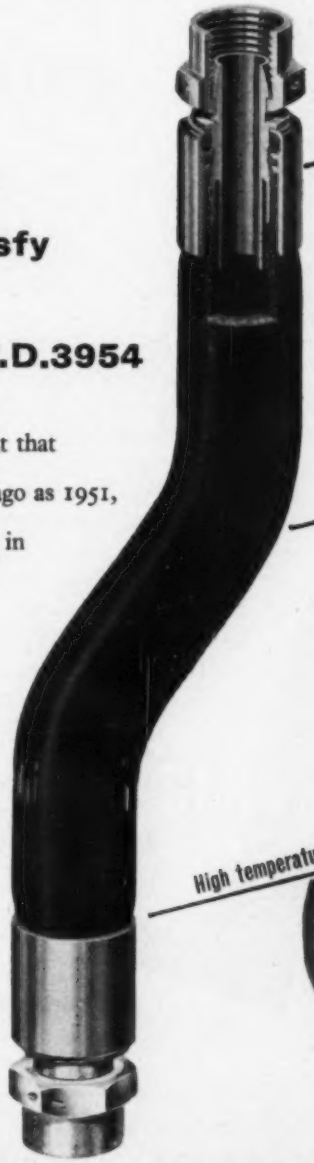

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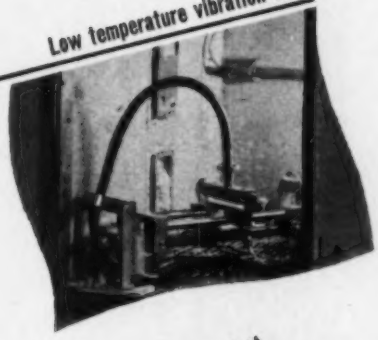
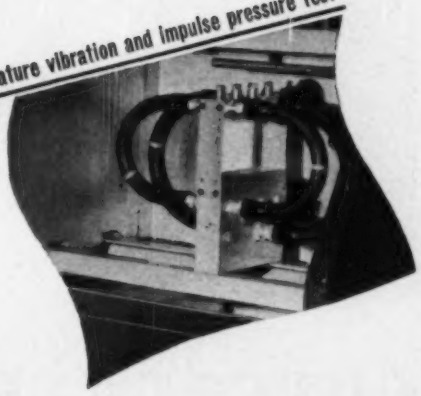


High temperature vibration and impulse pressure test



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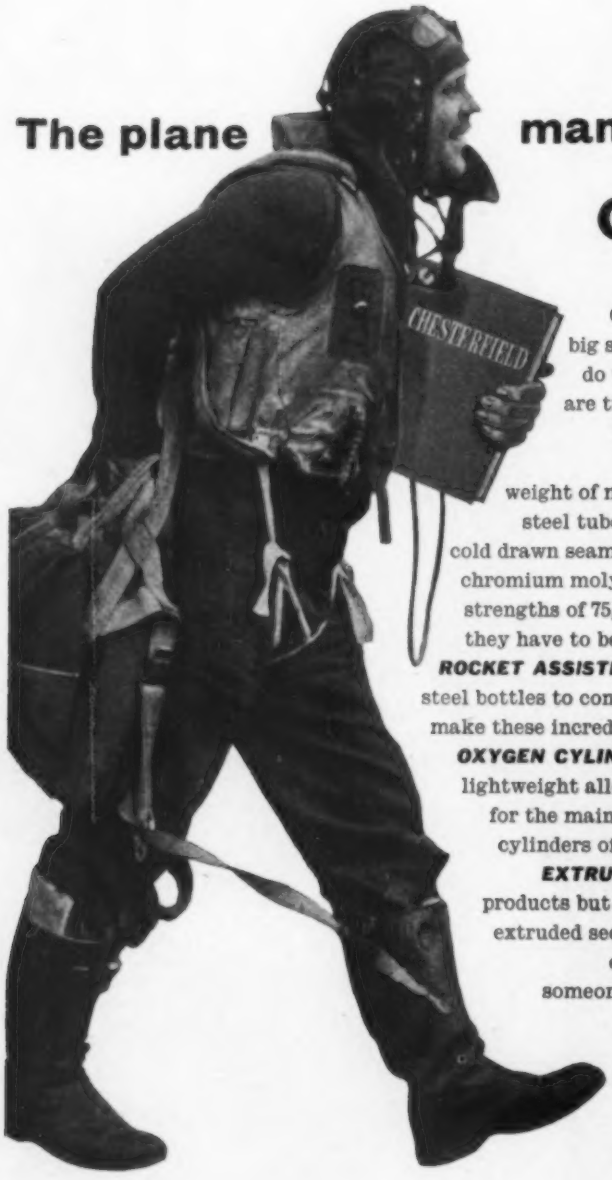

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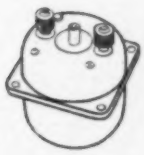

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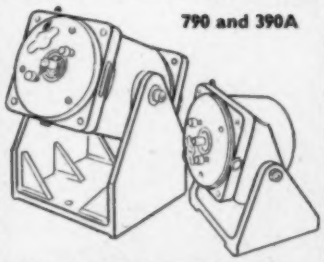

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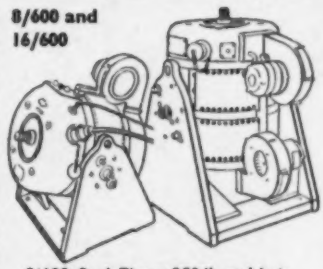

8/600 Peak Thrust 250 lb. at 1 kc/s. Range up to 1,000 c/s.

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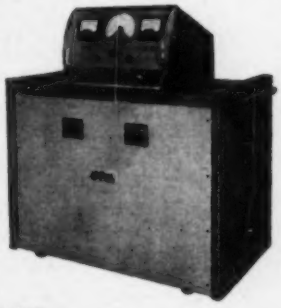

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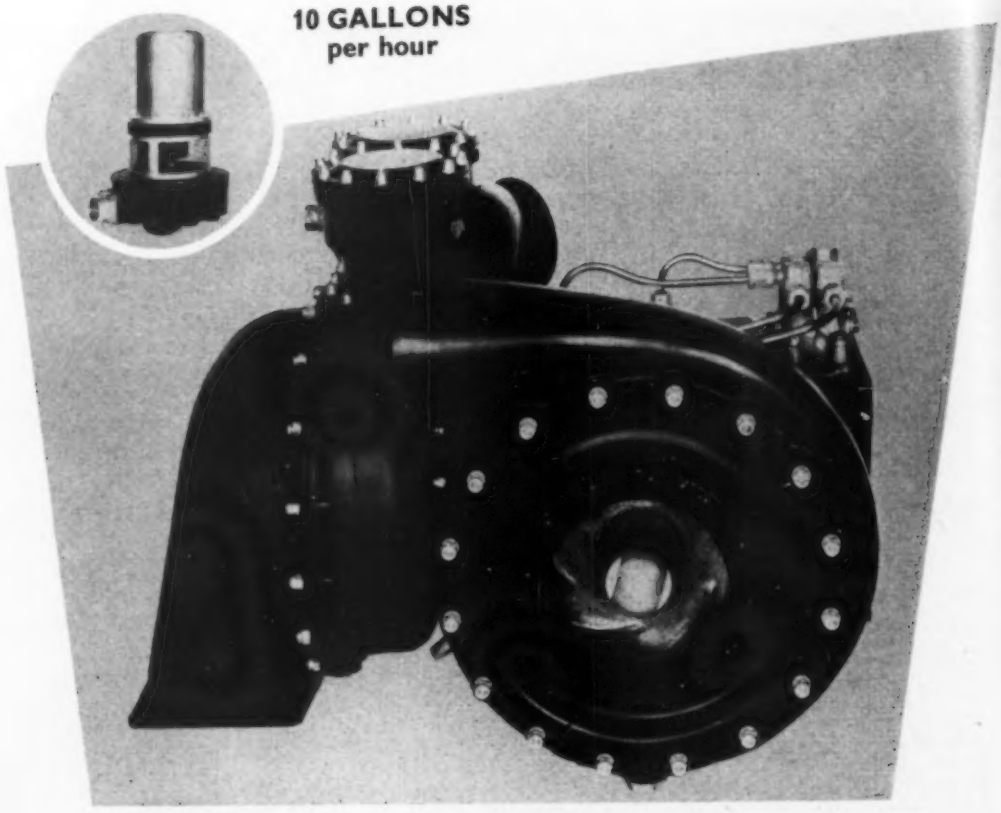

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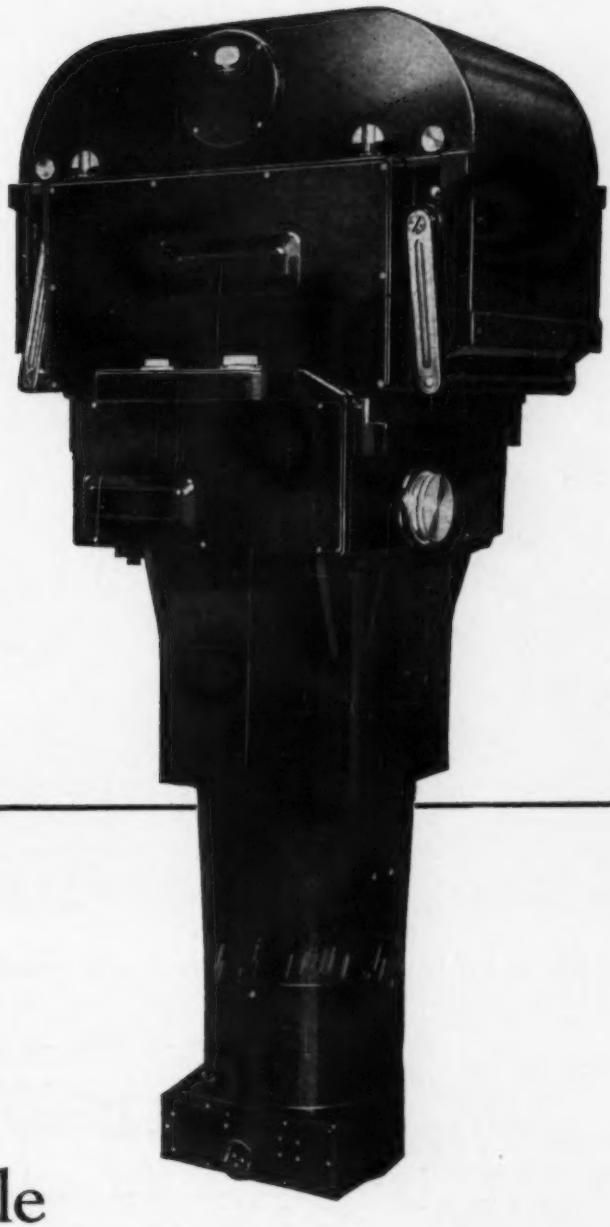

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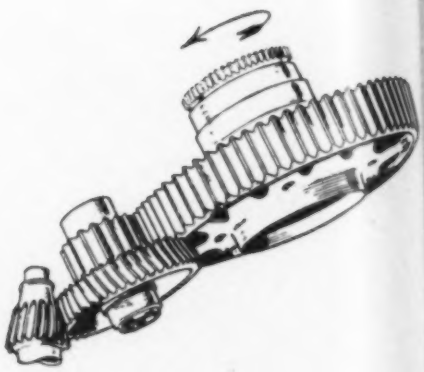

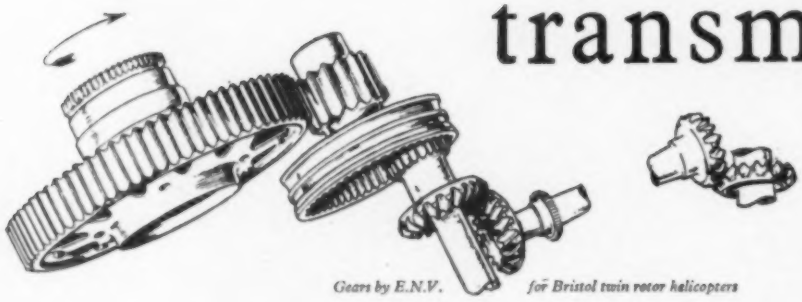

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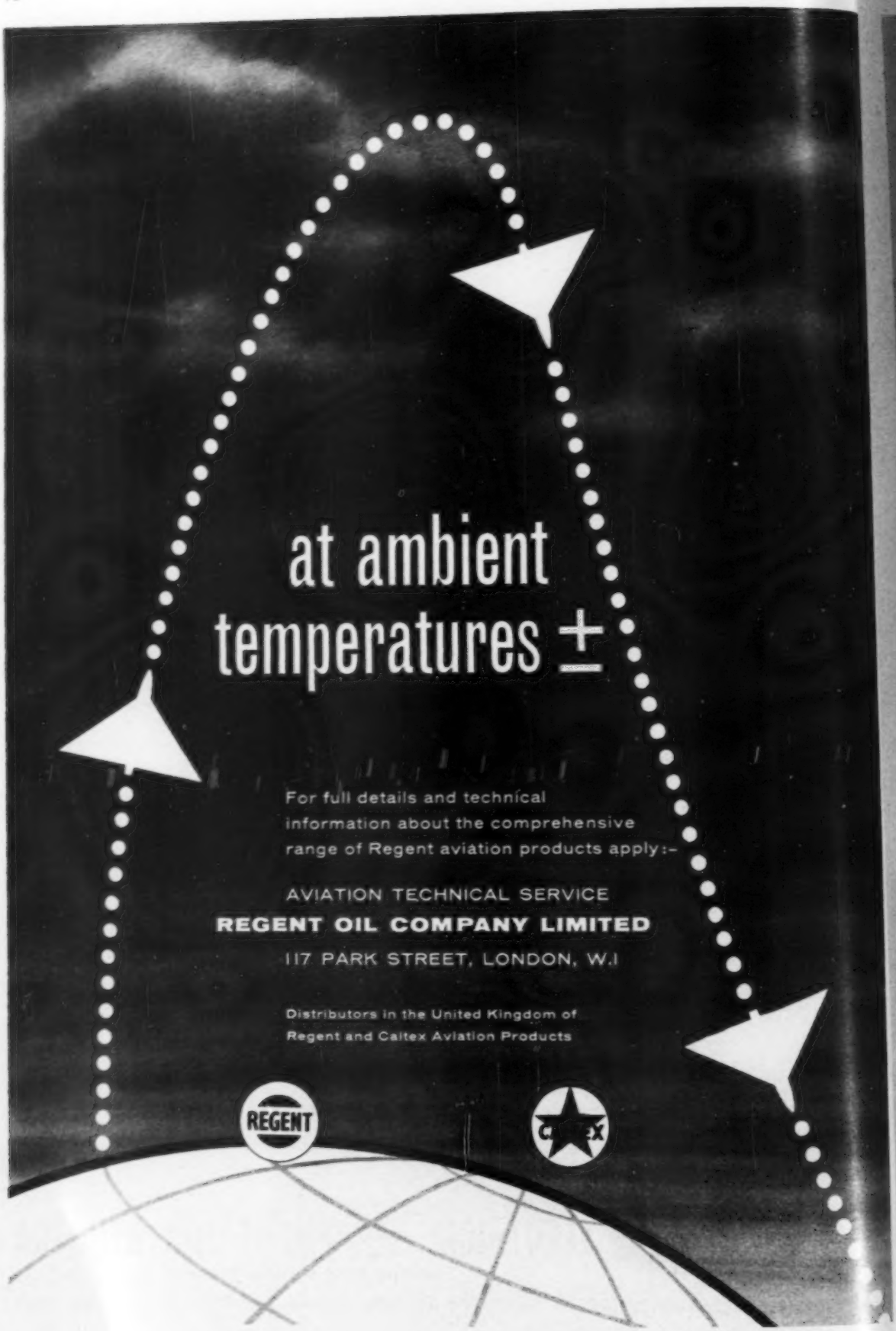
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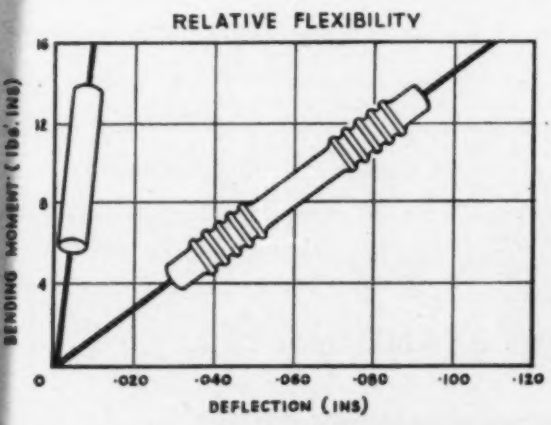

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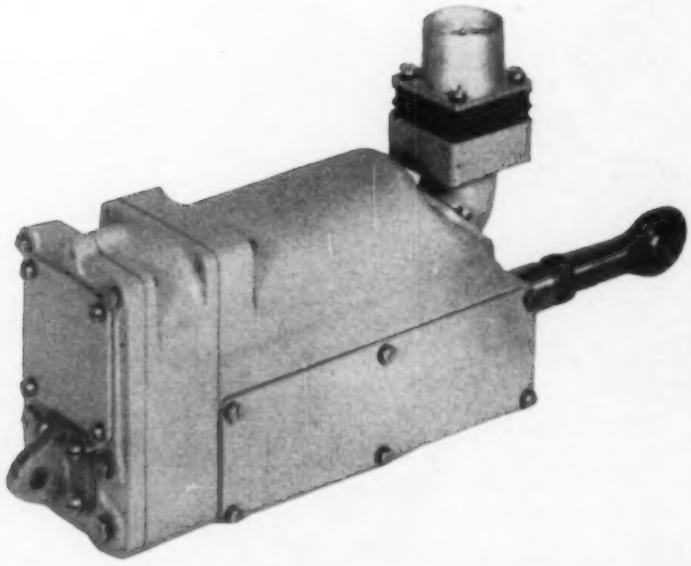

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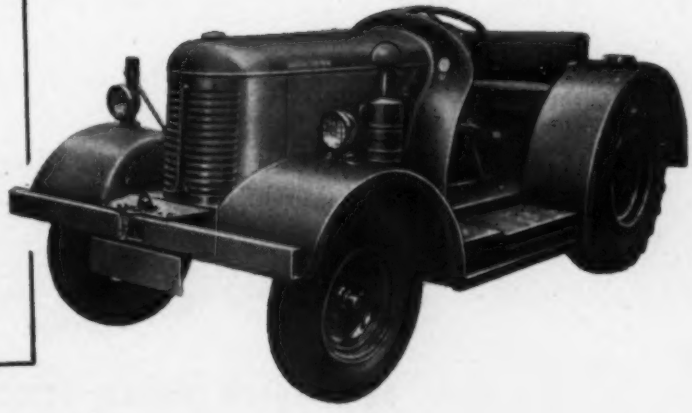

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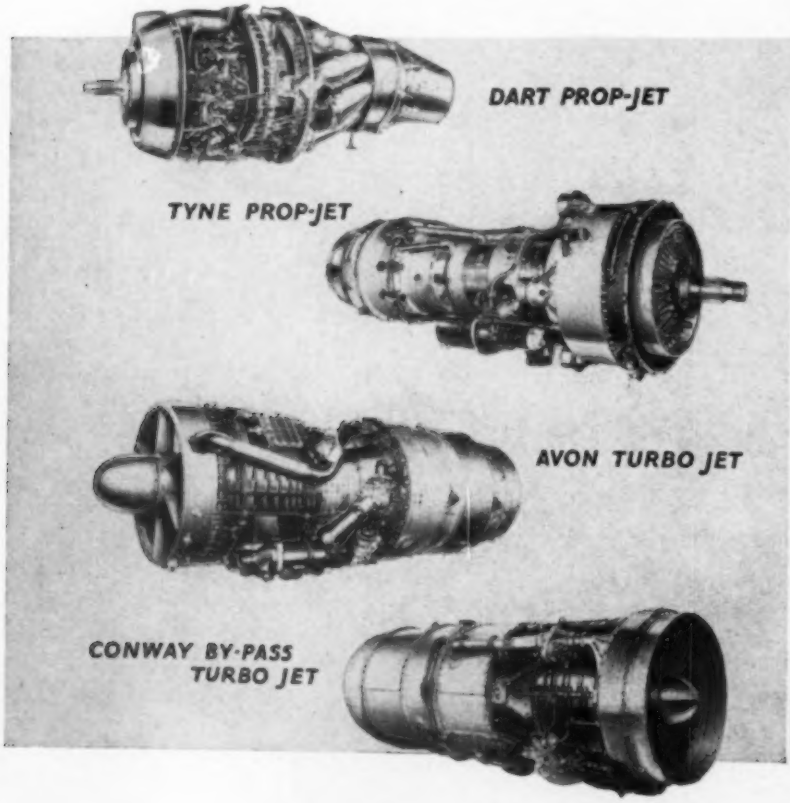

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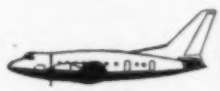

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2536 Vol 72 FRIDAY 30 AUGUST 1957

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The Mirror of Farnborough

DOUBTLESS to the puzzlement of our visitors, the British Aircraft Industry will be reflecting a not unhealthy appearance in the mirror of the eighteenth S.B.A.C. Display. For a mirror this occasion most certainly is—more so than the shop window it is generally considered to be. A mirror, moreover, which is not of the distorting kind, such as delegates to the Anglo-American Conference might encounter when, with the Display behind them, and the day's business over, they seek diversion on the South Coast promenades.

Puzzled, as we say, our friends may very well be; for they recall that in the twelve months since they were last among us the constitution of our industry has been rudely shaken up. But here may lie, in part, the explanation; for a good shake-up can prove a salutary exercise as well as an opportunity for clinical observation. In the long run the patient may be all the healthier for both.

So, while our friends are not likely to come upon us flexing our muscles in front of the mirror and banging our chests in confident exuberance, they will not, on the other hand, discover us cringing in some dark corner, quaking in fear of the future. The truth is that we know what has been wrong with us—and what is still wrong. Certainly we should by now, for we have been told with sufficient frequency and authority. But we are setting about the cure, even though details of the treatment are not agreed by all concerned. Meanwhile, our metabolism is undergoing a marked alteration—which is only to be expected in these days of shifting emphasis, acute competition and financial stringency. Such constitutional changes as may come about, we reassure ourselves, can occur without the onset of atrophy or decay. The "croakers" we have to worry about are not the medical kind.

We know that more pains will be assailing us in the months ahead—constricting, griping, sometimes, perhaps, a little frightening. No doubt we shall continue to be plied with good advice, awful warnings and shock treatments: and we shall probably come out of it little the worse. Perhaps all the better.

For the present, then, we report ourselves as being pretty well, all things considered. And we hope that our visitors find themselves the same.

INTO THE LISTS, like some mighty lance-bearing warrior, thunders the English Electric P.1B supersonic intercepter fighter (two Rolls-Royce Avon turbojets). Dramatic performances during Farnborough week are expected of this aircraft, and others of the P.1 family.

"Flight" photograph

FROM ALL QUARTERS

Hawker P.1121

THIS designation is officially disclosed for the Hawker private-venture strike aircraft now under construction. The name Hurricane, very widely applied in the Press, has received neither official nor unofficial sanction. The power unit is confirmed as the de Havilland Gyron. The P.1121 should have a speed of the order of Mach 2, and would attack at such low levels that interception, either by missile or manned fighter, should present acute problems. The first prototype should fly next spring.

Soviet ICBM Progress

ON Monday, August 26, the Russian News Agency, Tass, announced that "a super long-distance intercontinental multi-stage ballistic rocket was launched a few days ago. The rocket flew at an . . . unprecedented altitude . . . and landed in the target area." This is the first claim for achievement of a successful flight by an ICBM; the first prototype WS-107A Atlas, launched on June 11, was detonated by command signal at 5,000ft following failure of a boost-motor fuel system.

Lt-Cdr. Dennis Kelly

WE regret to record that Lt-Cdr. D. P. W. Kelly, who had become well known at Naval air displays for his low-altitude aerobatic performances, was killed on August 26 when the Sea Hawk from R.N.A.S. Ford in which he was practising for Farnborough crashed near Arundel.

Lt-Cdr. Kelly, who was 31, had been given leave from the royal yacht *Britannia* to take part in the display. He joined the Royal Navy in 1940 as a Dartmouth cadet, started flying with the Fleet Air Arm in 1946, and in 1951—when commanding No. 806 Sqn. aboard *Theseus* during the Korean War—became the first pilot to ditch an aircraft from the carrier, being picked up by a Canadian destroyer.

U.S. Balloonist's 100,000ft Ascent

TO test human reactions under artificial conditions at the edge of the earth's atmosphere, a U.S.A.F. doctor, Maj. David Simons, last week ascended by balloon to a height reported to have exceeded 100,000ft (over 19 miles) in a flight which lasted altogether 32 hours.

Maj. Simons was accommodated in an aluminium gondola 7ft high and 3ft wide beneath a helium-filled plastic envelope designed to expand to a diameter of 202ft and began his ascent from Crosby, Minn, at 9.30 a.m. (2.30 p.m. G.M.T.) on August 19. He landed near Ellendale, North Dakota, at 5.28 p.m. (10.28 p.m. G.M.T.) on August 20.

The flight constitutes a record (so far as the F.A.I. is concerned, at present unofficial) both for altitude—variously reported as 102,000ft and 118,000ft—and for duration.

Cross-channel Gliding

THE first soaring flight across the English Channel by a woman was made by Mrs. Anne Burns on Wednesday, August 21. Flying in a Slingsby Skylark 3 from Lasham, Hampshire, to Lillers, 40 miles south-east of Calais, Mrs. Burns achieved a distance of 156 miles. The duration of the flight was approximately four hours, and the cross-channel section was begun from a height of 7,200ft over Folkestone.

Light Aircraft Radio Compass

AT Southend airport last week Elliott Brothers (London), Ltd. demonstrated the very small French radio compass (*Flight*, June 7, p. 775) produced by Air Equipement for the French Government sporting flying movement and now ordered for the French Air Force. Called the RCB-2, the radio compass weighs a mere 10 lb, covers frequencies between 200 and 800 kc/s, and will operate from a 12V or 24V generator supply. It has 16 transistors and 11 valves, and the whole receiver is fitted behind the very small control panel. The iron-cored loop is housed under a small plastic transparent dome. Indicator and receiver were both accommodated comfortably in the space between coaming and windscreen of the demonstration Tri-Pacer.

The British company is considering producing the RCB-2 under licence. Drawings are to be studied and, after a certain amount of modification such as changing to English valves, a prototype could be produced in a matter of months. Apparently no firm decision to produce has yet been taken; and no estimate of price has been given. During the demonstrations, the RCB-2 was tried by airline, flying club and M.T.C.A. representatives and obviously performed very well.

"FLIGHT" NEXT WEEK will contain a first-hand, fully illustrated report of the S.B.A.C. Show opening, together with special articles and regular features

MAGISTER MARINE: The French Navy's new jet trainer—a development of the land-based Fouga Magister—has been undergoing trials aboard H.M.S. "Bulwark" (the French Navy not yet having in operation a carrier with angled deck). Two examples have been tested, and one is seen here being made ready for catapult launching.

***VULCAN PRODUCTION** is illustrated for the first time in this picture of Avro's Chadderton works. Vulcan B.1s are now being issued to No. 1 Group of R.A.F. Bomber Command, and the much-improved Mk 2 version is expected at Farnborough.*

IN BRIEF

As we go to press the M.o.S. confirm that financial support has been withdrawn from "a research project" on which Dr. B. N. Wallis and a Vickers-Armstrongs team have been working for some years. The project is understood to have been an aircraft of highly unorthodox type.

* * *

The first demonstration at sea of the new Bell Aircraft automatic landing system for carrier aircraft was recently given with an F3D Skyknight aboard the carrier *Antietam* off the Florida coast. The pilot, Don Walker, did not touch the controls during any of the seven landings made.

* * *

Appointed to the Board of Fairey Air Surveys, Ltd., Mr. W. P. Smith, M.B.E., B.A., F.R.I.C.S., has been chief surveyor for the company since August 1954. He joined Fairey Air Surveys (then the Air Survey Co., Ltd.) as general manager in November 1950, after conducting surveys in Nyasaland, Kenya and Rhodesia as senior surveyor with the Directorate of Colonial Surveys. In December 1951 he was appointed director and general manager of Fairey Air Surveys' Rhodesian company, and two-and-a-half years later became chief surveyor of the parent company.

* * *

de Havilland Propellers, Ltd., have secured a substantial dollar order from Canada. The eight Canadair CL-44s which are being supplied to the R.C.A.F. will be fitted with entirely new 16ft-diameter propellers of de Havilland design and manufacture, having four solid aluminium blades with a wide chord and square tips. Among the new features incorporated are a mechanical automatic drag-limiting device (to reduce drag if an engine fails); both mechanical and hydraulic pitch-locks; and Beta control—blade-angle control for reversing and ground handling. Pitch range is limited by a withdrawable mechanical stop, beyond which blade angle is directly controlled by a movement of the throttle lever; a wide range of positive and negative blade angles is thus available to the pilot.

* * *

As briefly announced last week, Mr. Ernest Ower, B.Sc., A.C.G.I., F.R.Ae.S., has been appointed chairman of Teddington Aircraft Controls, Ltd. He joined the Board of the parent company—the British Thermostat Co., Ltd.—in January this year, and had previously been intelligence officer to the British Shipbuilding Research Association. Mr. Owers' connection with the aircraft industry is of long standing, for from 1918 to 1940 he was engaged on aerodynamics research at the National Physical Laboratory; from 1925 to 1940 he was assistant secretary of the Aeronautical Research Committee; and from 1940 to 1945 secretary of the Advisory Council on Scientific Research at the M.o.S.

FORETASTE OF FARNBOROUGH

YEARLY, coincident with preparations for the S.B.A.C. Display, comes a burgeoning of "releases"—new information on, and pictures of, new aeroplanes and engines (and this year of new missiles also). The extent and quality of the 1957 yield is evident from these pages, and from the first detailed description of the Bristol Bloodhound (pages 291-292).

Lest some readers should feel some of the gilt is thereby removed from the Farnborough gingerbread, we would advance as our professional opinion that *Flight's* Farnborough Report next week will be more richly spiced with news than for many years past. And if we read the signs aright, by no means all the Farnborough-week news will be of a technical nature.

Iroquois in London

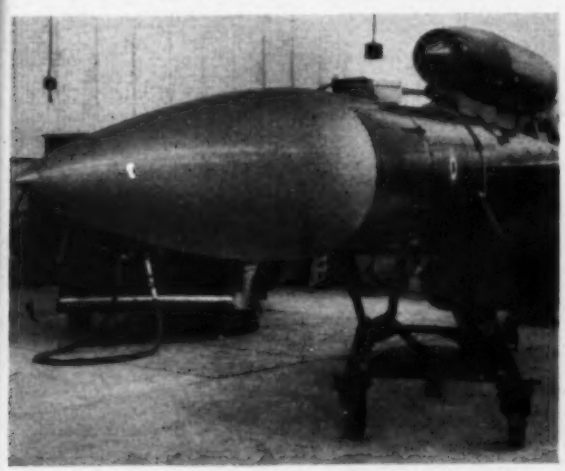
FOLLOWING speeches by Mr. George A. Drew, P.C., Q.C. (High Commissioner for Canada), Mr. Walter R. McLachlan (president and general manager, Orenda Engines, Ltd.) and A.V-M. D. M. Smith, C.B.E., C.D. (chairman of the Canadian Joint Staff), the Iroquois supersonic turbojet was "unveiled" by Sir Roy Dobson, chairman of A. V. Roe Canada, Ltd., at a ceremony in Battersea Park, London, on the evening of August 26.

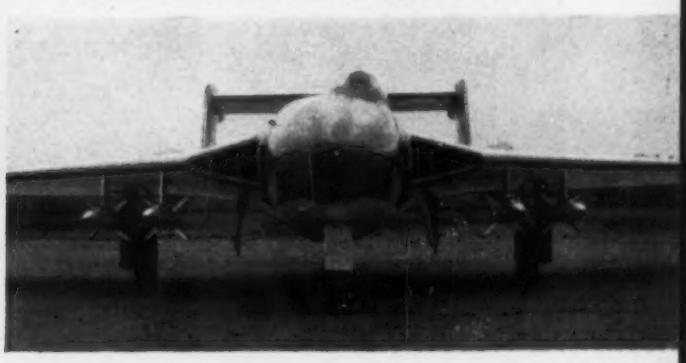
Firestreaks in Strength

NO fewer than 23 de Havilland Firestreak air-to-air missiles are likely to be seen in the S.B.A.C. Display. At least eight will be affixed to aircraft—four on a Javelin FAW.7, two on a Hunter F.6, and two—surprising and welcome news—on the Saunders-Roe SR.53. It is hoped that Firestreak deliveries will be starting in eighteen months or less.

Rocket Box

SECURITY-RELEASED for public exhibition, a rocket launcher "initially designed for wing-pylon installation on fighter-type aircraft" will be shown by the Microcell group. Moulded from glass-fibre, it accommodates 37 two-inch missiles —a slightly smaller diameter than the U.S. Mighty Mouse.





***THE NEXT DEFENCE:** New angles on British guided missiles—left, Bristol's Bloodhound, showing the fairing over the semi-active homing radar; below, a D.H. Sea Vixen FAW.20 carrier-borne all-weather fighter with four de Havilland Firestreaks. The Bloodhound weapon-system is described in an article on pages 291-292.*

FORETASTE OF FARNBOROUGH . . .

Britain's Combat Rocket

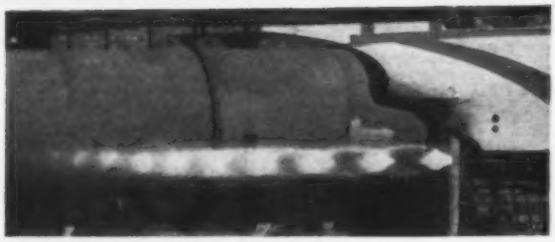
ROCKET engineers at de Havilland tend to shudder at the mere mention of nitric acid or liquid oxygen; in their view, high-test hydrogen peroxide—H.T.P.—is *the* propellant for manned flight. They have stuck to this view for 12 years, for reasons which were made plain at a Press conference last week.

The purpose of the gathering was to demonstrate for the first time in public the consummation of six years' work by the D.H. Engine Company's rocket division—the Spectre. This engine (the word engine is recognition of the years of difficult engineering and testing which separate the Spectre from the early days of "rockets" and "rocket motors") has just been released from its tight security grading, permitting the description which appeared in *Flight* last week.

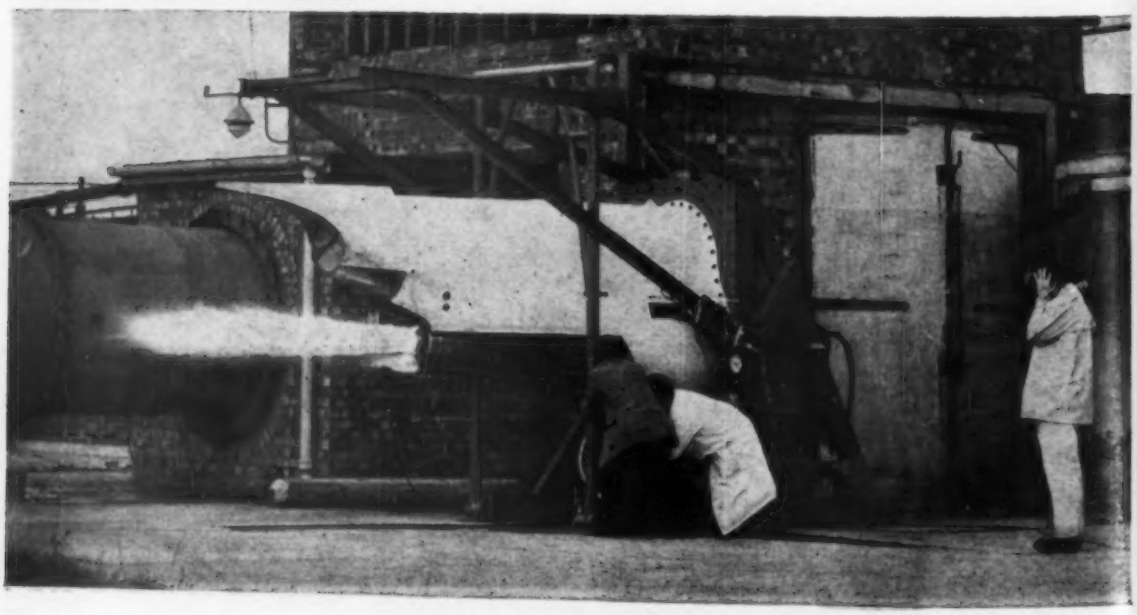
It was a full-day programme, beginning with talks at Leavesden (the company's headquarters) by de Havilland engineers and by Mr. M. J. Brennan, the chief designer of Saunders-Roe. His SR.53 intercepter, the first British fighter with mixed rocket and jet propulsion, and employing the Spectre as its primary combat powerplant, is illustrated by a new action-picture on this page.

The party was taken to the test establishment at Hatfield for demonstrations. These began with chemistry lessons in the docile properties of H.T.P., all no doubt aimed at showing what could *not* be done with the more bad-tempered propellants. Mr. W. N. Neat, de Havilland's chief rocket engineer, poured it on his hand, even plunged a piece of silver-gauze catalyst in a beaker of H.T.P. with no more commotion than a hiss of steam. The liquid was thrown on the ground, mixed with ignited kerosine (and then quenched with plain water), and generally sloshed around. The point was made: that H.T.P. is safe to handle and, presumably, to store; and that fallible human beings—ground-crews in the stress of front-line action and pilots in crash landings—need not fear it. Other oxidants may be cheaper or may offer a higher specific impulse: but H.T.P. seems to have been the D.H. choice in that firm's tradition of doing business by keeping things simple. (The old argument for single-sided centrifugal impellers was technically dead seven or eight years ago, but D.H. are still selling Goblins and Ghosts.)

The contrast between the decorous chemistry lessons and the mind-splitting demonstration firings that followed was remarkable. First the Super Sprite take-off rocket—a savage 40-second test-bed burst of the kind which allows fully laden Valiants to scorn long runways. Next the Spectre demonstration, the climax of the day. It seemed impossible that a man-engineered device could produce and endure such power and noise for so long, *and* remain in perfect control. The orange tongue of shock-diamonds licked in and out of the SR.53 test section at the whim of the controller, while two colleagues nonchalantly made a close-up inspection of the feed system. They were substantiating one of Mr. Neat's earlier observations—that gone are the early rocket-research days of "lighting the blue touch-paper and retiring immediately."



Top, the de Havilland Spectre at work in the SR.53. Above, shock-diamond formation at full power on the test bed. Left, H.T.P. propellant being "generally sloshed around." Below, Spectre inspection during a controllability demonstration.



"...LOCAL CONFLICT...

Global war is not the Clausewitzian 'continuation of policy by other means' but the negation of all policy. It is inconceivable, therefore, that it could arise except by accident, from a local conflict which got out of hand. The deterrent against the local conflict is therefore the root of all deterrence."

THE TIMES, 5th April 1957

So vast is the destructive power of the megaton bomb it could not be used unless the very existence of a nation was at stake. Yet between this extreme and peaceful coexistence a whole range of conflicts is possible—conflicts that do not justify weapons of mass destruction. Conventional force can be the only effective deterrent to local conflict—and a strong air force must be the first consideration.

The GNAT light jet fighter has established a brilliant concept in modern air defence, avoiding the penalties of size, weight, bewildering complexity and staggering cost. Compared with the conventional fighter it has the same speed, better manœuvrability and greater operating height, coupled with the most advanced armament and equipment. As a modern tactical fighter the GNAT is the right aircraft, for the right job at the right time.

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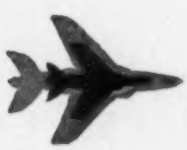
LIGHT JET FIGHTER



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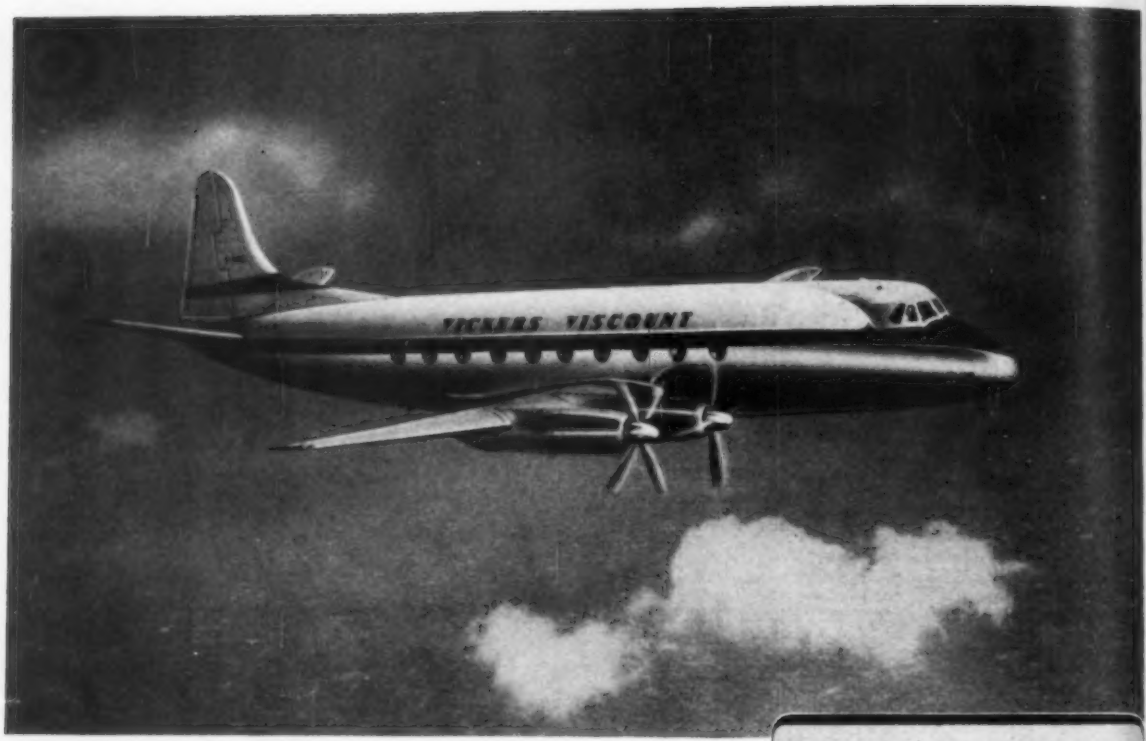


Tucker "Pop" Rivets

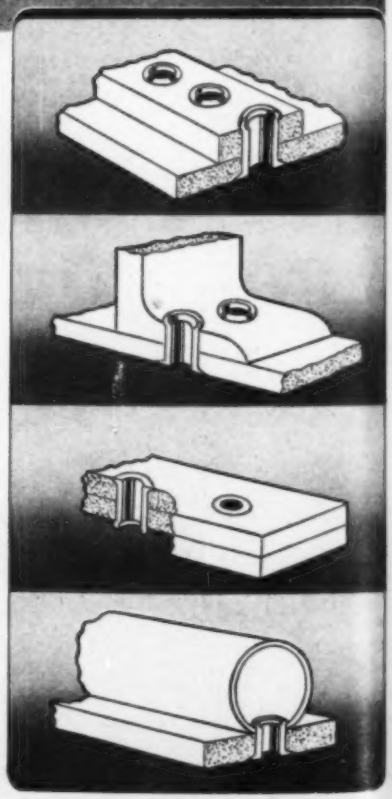
and the Vickers Viscount

In the same way that the record breaking efficiency of the Vickers Viscount has justified the confidence of operators in all parts of the globe, so has the 'POP' Riveting system justified the confidence of Vickers-Armstrongs and the many other manufacturers who use it extensively in the assembly of their aircraft.

Requiring only one operation by one operator to set or clench the rivet, this modern system of riveting eliminates errors in setting, prevents distortion of the structure and enables rivets to be set in positions inaccessible by other methods.

See this modern system of riveting at the Exhibition of the Society of British Aircraft Constructors at Farnborough.

Stand No. 179



Photograph of "Viscount" by permission of Vickers-Armstrongs (Aircraft) Ltd.

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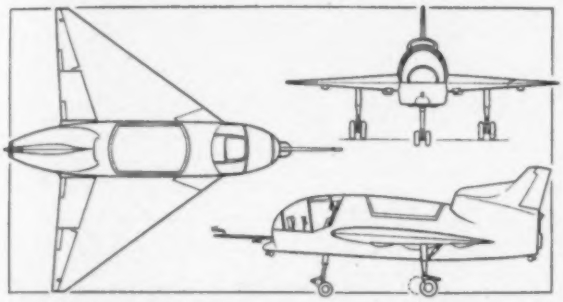
DOG TOOTH leading edge on a Hawker Hunter F.6. All R.A.F. Hunters are being retrospectively modified to incorporate this development.

GENERAL-PURPOSE VEHICLE is the classification of this Short missile, used, in association with Elliott Bros. (London), for homing research.



MAKER'S DRAWING of the Short SC.1 vertical take-off research aircraft (five Rolls-Royce R.B. 108). This supersedes the provisional drawing on page 320 and shows the recently added dorsal fin.

FORETASTE OF FARNBOROUGH . . .

All-round Soldier

THE Scottish Aviation Twin Pioneer (Military) is a general-purpose STOL aircraft for which no Service name has yet been announced, and it is now in production for the R.A.F. It is suitable for communication, troop transport, paratrooping, air-freighting, casualty evacuation, supply-dropping, bombing (H.E. and anti-personnel), and can have increased tankage for inter-theatre ferrying (up to 1,500 miles). Operation is possible from rough improvised strips no more than 300 yards in length. The 16-passenger version is air-conditioned and has a range of 190 miles. Carrying 12 troops the aircraft can fly for 200 miles, or with nine paratroopers for 400 miles.

In the supply-dropping rôle the aircraft will take 3,400 lb for 100 miles, or as a pure freighter 2,000 lb for 640 miles. In the casualty-evacuation case 12 casualties can be lifted for 500 miles. With a bomb load of 2,000 lb the Twin Pioneer has a range of 640 miles, or with eight 20 lb fragmentation bombs it can cover 1,260 miles. As an alternative to the bombs four 500 lb containers can be attached. The bomb-aimer's prone position is in the cabin (see drawing), with the bomb-sight and electrical control panel below floor level.

In addition to the 371 gal carried in the normal wing tanks, one or two tanks of 100 gal can be installed in the cabin for ferry duties.

As we close for press we learn from Mr. David McIntyre, Scottish Aviation managing director, that a military Twin Pioneer will be on show in the static park at Farnborough, together with its various military accoutrements. The company has "great hopes" of further military orders.

Big Service Contribution

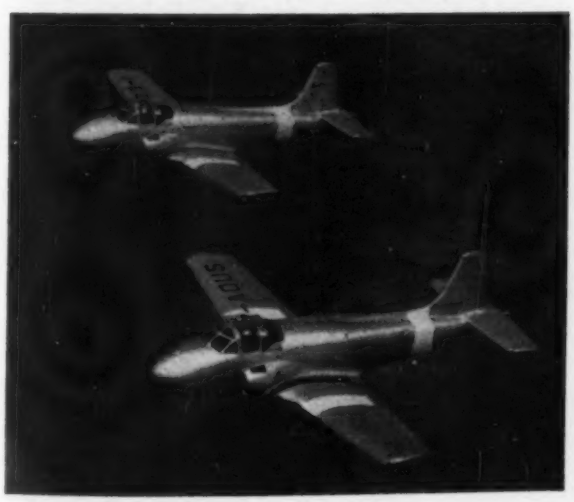
MORE than 50 aircraft from Bomber Command, nearly 60 from Fighter Command, and four from Flying Training Command will represent the R.A.F. at this year's S.B.A.C. display at Farnborough.

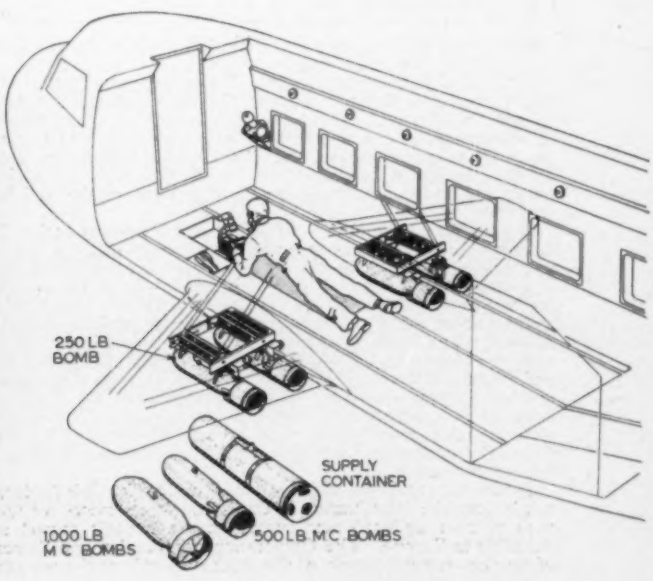
The Bomber Command contribution will include Valiants and Canberras, and a "loose formation fly-past" by the three types of V-bomber; Fighter Command are putting on fly-pasts by 27 Hunters and 27 Javelins, and formation aerobatics by five Hunters from No. 111 Sqn.; while four piston-engined Provosts will represent Flying Training Command with a low-flying and aerobatic display.

The Bomber Command Valiants and Canberras will use Farnborough as a target during operational exercises, and while they are passing over, the other R.A.F. aircraft will display at low altitude.

As briefly reported in these pages last week, the Fleet Air Arm is contributing 12 Gannets (fly-past in anchor formation); aerobatics by five Sea Hawks; and Whirlwinds "performing a Calypso."

IN AND OUT OF CIVVY STREET: Wearing civil markings below are two Hunting Percival Jet Provost development aircraft. In military guise (as a bomber) on the right is the Scottish Aviation Twin Pioneer.





Progress with Lockheed's first Electra is proceeding fast. The wings were attached to the fuselage earlier this month and wiring, insulation, electrical and hydraulic equipment are now being installed. The undercarriage and tail unit will be added shortly.

CIVIL AVIATION

B.E.A.'s YEAR

A PRELIMINARY study of B.E.A.'s annual Report and Accounts for the year ended March 31, 1957 (published on Tuesday of this week, August 27) indicates that the net profit of £216,770 was achieved in adverse circumstances. At times during the year it had seemed that the Corporation might not scrape home with a profit at all, and the annual report makes it clear that the battle against rising expenditure and declining traffic revenue rates was the hardest yet fought. "The resilience and flexibility of the airline," states the chairman, Lord Douglas, "were put to the test, and a profitable position was maintained even though the traffic revenue rate was reduced to the lowest level in the history of the Corporation." Gross profit, before deduction of interest on capital, was £830,462.

A summary of the main results is provided in the table below.

Main Items	1956-57	Percentage over 1955-56
Capacity ton miles flown	139,078,802	+11.7
Load ton miles sold	89,685,423	+14.0
Revenue load factor achieved	64.5	+2.1
Passenger load factor achieved	70.3	+1.3
Passengers carried	2,461,065	+10.6
Passenger miles flown	808,872,028	+14.1
Freight ton miles carried	9,227,790	+22.3
Operating revenue earned	£23,947,774	+10.9
Total expenditure incurred	£23,731,004	+13.0
Net profit	£216,770	−64.1
Total cost per capacity ton mile	41.0d.	+1.2
Traffic revenue per load ton mile	61.8d.	−2.8

The salient points from the report, which we hope to examine more fully in a later issue, follow.

B.E.A. had planned their business for the year on an expected traffic increase of about 20 per cent. In actual fact, the increase in load ton-miles sold was 14 per cent. The reasons were mainly (1) the slower rate of industrial growth, i.e., national income, as a result of the credit squeeze, and (2) the conflict with Egypt and the disturbances in Cyprus and the Middle East, affecting traffic on routes which are "exceptionally important in the B.E.A. economy."

Despite fare increases (5 per cent on both international and domestic services), the average rate per passenger-mile on international services—which contribute 77.3 per cent of the traffic revenue—actually fell. The reason was "largely due to an increase in the proportion of excursion-fare traffic." The report devotes some space to relations with the independent airlines, some of whose inclusive tour operations and Colonial-coach services (to Cyprus and Gibraltar) have been "harmful" to B.E.A. and "impinged seriously" on its activities. The volume of summer holiday services operated by the independents has "caused material diversion of traffic from B.E.A.'s services." The report concedes that "new" traffic may have been generated by the Colonial-coach services, but does not believe that the services are dependent upon it.

Future fares policy is discussed at some length. B.E.A. does not believe the introduction of third-class fare services (of the type to be introduced next spring on the Atlantic routes) is desirable in Europe. The Corporation believes that two classes of service—not necessarily of the same standards as the present services—are desirable, and B.E.A. is discussing with other European operators a policy to take advantage of increased seating capacities and simplified cabin service. The fare reduction might not be large, however. The introduction of mixed-class services to offer greater first-class frequency—a class of business for which an increasing demand is foreseen—might be possible. B.E.A.'s policy would be to work towards the operation of first and tourist services by day and "very low fare" tourist services at off-peak times, 1959 being the target date for such changes.

During the past year, the Corporation has made "more detailed study than ever before" of the future traffic prospects of all its routes. The Corporation judges that its traffic will increase by 85 per cent in the next five years. From this study B.E.A. concluded that "caution should be exercised in the build-up of the Viscount fleet in the years immediately preceding the introduction of the Vanguard." B.E.A. therefore decided not to exercise its option on seven Viscount 810s. The present fleet plan is as follows:—

DC-3 Pionairs (38 aircraft) to be retired from service, starting in the autumn of 1958 and withdrawn by the autumn of 1960. *Elizabethans* (19 aircraft) to be retired from service, starting in 1957. (Six have already been sold.) *Viscount V.701* (25 aircraft) to be converted to high-density configuration mainly as a replacement for the DC-3 Pionair, starting in the winter of 1958/59 and completed by the spring of 1960. *Viscount V.802* (24 aircraft) started service in February 1957, and all aircraft are to be in service by end of summer 1957. *Viscount V.806* (16 aircraft) to enter service in the summer of 1958 and all aircraft to be in service by the autumn of 1958. *Viscount V.840* (12 aircraft); an option is held on a number of these aircraft, and if this is taken up they will enter service in the summer of 1959. *Vanguard* (20 aircraft), to enter service in the summer of 1960.

As in previous years, the Viscount 700 was the only aircraft to make a profit (£620,599). The biggest loss—£1,045,995—was incurred by the DC-3 Pionair fleet.

The second conclusion reached from its study of future traffic prospects was that B.E.A. could not afford to be without a jet in the early 1960s—a conclusion reached "not without certain misgivings." Turboprops are, in B.E.A.'s view, the most satisfactory vehicles for their routes, but it is inevitable that B.E.A. will face on some of its European routes competition from jets which will be 125 m.p.h. and more faster than the 425 m.p.h. Vanguard. "B.E.A. believes that the cost difference between jet and turboprop services on short and medium sectors warrants the introduction in Europe of a fare differential between these two kinds of aircraft." Whether or not such a differential is agreed by I.A.T.A., B.E.A. will need a small number of jets "as early as possible in the 1960s." A specification was drawn up, discussions with B.O.A.C. about a possible joint specification were reluctantly dropped ("the requirements being too far apart") and "several aircraft manufacturing firms" had put forward projects to meet the B.E.A. jet requirement. This is for an aircraft with 75 to 80 seats, cruising at "almost 600 m.p.h." and able to carry full payload for 1,000 miles. "The Corporation expects shortly to make a decision on the project considered most suitable, and to place an order for the short/medium haul jet aircraft we require and for which we think there will be a substantial world market."

BREVITIES

THE new West London air terminal for B.E.A. is now practically complete. The transfer from Waterloo Air Terminal to the new site—in Cromwell Road, South Kensington—will be made on October 5/6.

* * *

Passenger manifests need no longer be completed in the U.K. for flights to most countries in Europe after September 1.

* * *

B.O.A.C.'s Britannia services to Ratmalana Airport, Ceylon, have been deferred because of the condition of the runways.

* * *

T.W.A. may use Convair 880s in Europe on the extensions of its transatlantic routes.

* * *

As a result of the merger of L.A.I. with Alitalia, the five L.1649As ordered by L.A.I. will be sold to Venezuela. Some of the airline's Viscounts may also be put up for sale.

* * *

The M.T.C.A., in Civil Aviation Information Circular No. 72/1957, draw attention to a new addition of C.A.P.90 *Flight Radio Operators Licences*.

* * *

Khartoum airport will be closed for repairs from October until January. Wadi Seidna airport, 11 miles away, will be used in its place.

* * *

On September 5, C.P.A.L. will extend their Toronto-Montreal-Lisbon services to Madrid. Services to Latin America will be extended to Santiago on September 23.

Aer Lingus Success

Mr. J. F. Dempsey, Director and General Manager of Aer Lingus, said recently, "Our fleet of Viscounts played a major part in the success of our twenty-first year of operation, enhancing both our prestige and our business. They have enabled us to provide our passengers with a higher standard of complete comfort and speed. Our salesmen have had something extra to 'sell' in the Viscount and as a result our traffic has shown a steady increase since we acquired these excellent aircraft."

Pilots have many reasons for preferring the Viscount with its proved and reliable non-powered flying controls.

Viscount experience in service with nearly 20 airlines is being built into the simple functional cockpit and cabin layout of the new Viscount 810-840—ensuring for both pilots and passengers that comfort and freedom from strain which is now associated with Viscount travel. In this new Viscount the proved dependability of the airframe and the Rolls-Royce propeller-turbine, after ten years of development and 1½ million flying hours, means peace of mind for both crew and passengers. Quiet, smooth flight reduces fatigue and improves efficiency, while the rapid turnround due to ease of maintenance means less worry over schedules.

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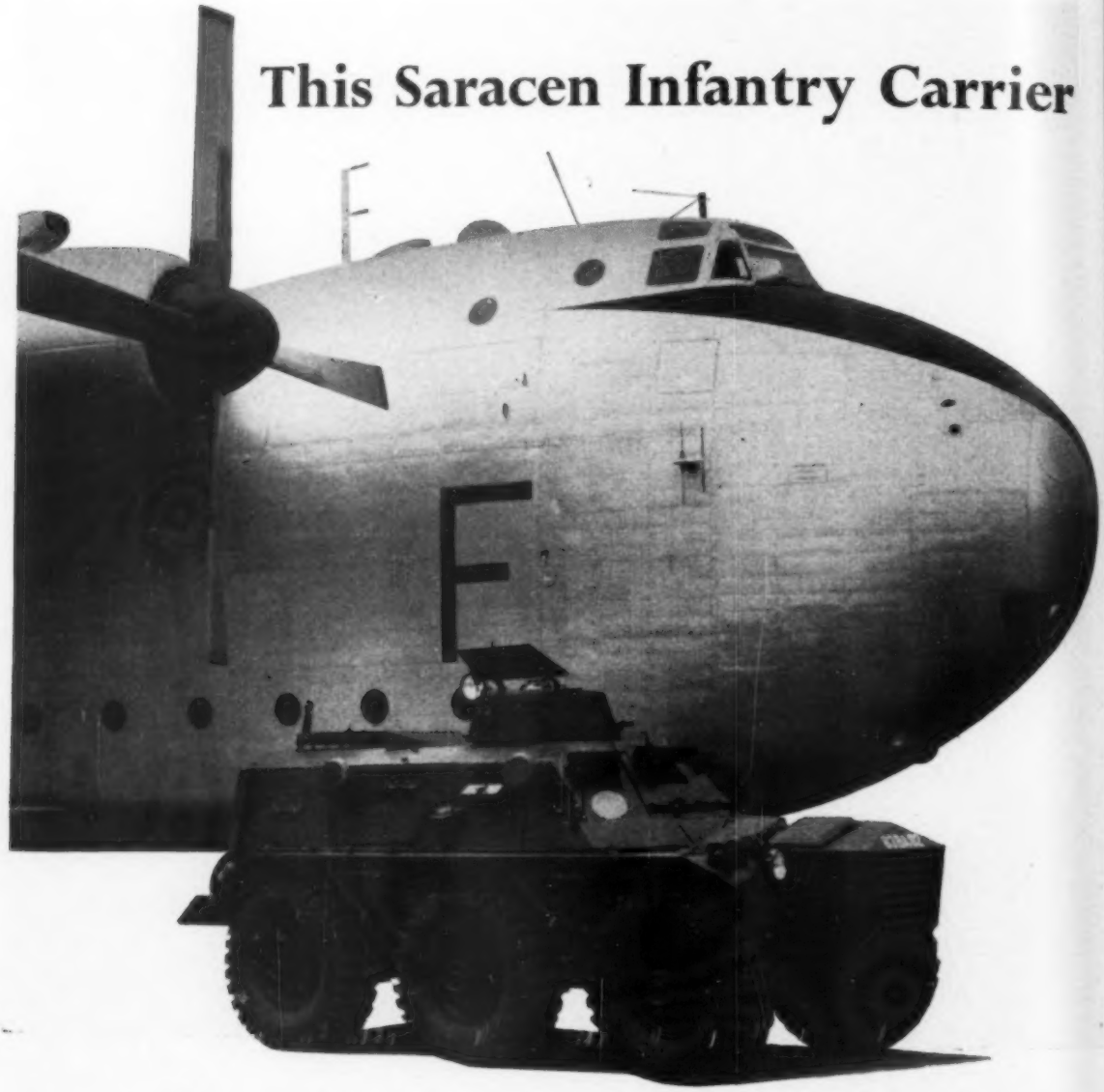

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BLOODHOUND

The Bristol/Ferranti Surface-to-air Weapon

The specially prepared—and security-modified—Bloodhound displayed in firing position on its launcher at Filton.

VISUAL revelation of the Bristol Bloodhound provides encouraging evidence of British guided-weapon progress. Perhaps an observer long associated with manned aircraft feels naturally receptive towards a missile that is a miniature aeroplane rather than a dart or a rocket; but whatever the reason, one's reaction towards Bloodhound is that it "looks right."

It was shown to us by Mr. Peter Masefield, managing director of Bristol Aircraft, Ltd., and Air Marshal Sir Alec Coryton, managing director of Bristol Aero-Engines, Ltd. Airframe design, said Mr. Masefield, was in charge of a team headed by Mr. D. J. Farrar under the general technical direction of Dr. A. E. Russell, while the Thor ramjet powerplant was developed by Mr. M. A. Nedham's team under the leadership of Dr. R. R. Jamison, head of the ramjet division. The Wythenshawe branch of Ferranti, Ltd., had worked closely with Bristol upon the associated guidance radar, electronics and control equipment from the very beginning, its team being headed by Mr. Alan Robinson under Dr. Norman Searsby, manager of the company's guided-weapon division.

Five factories are now engaged in producing the components of the Bloodhound weapon system for the R.A.F.; Ferranti at Manchester; Bristol Aircraft at Filton, Cardiff and Weston; and Bristol Aero-Engines at Patchway. Mr. Masefield said that this is the largest guided-weapon development and production organization in Western Europe. (The total Ferranti staff is some 12,000 strong, while the Bristol companies employ double that number.) The Bristol/Ferranti team was the last to come into the guided-weapon picture on a major project (this was in 1949) and is now proud to be the first to go into production with a surface-to-air weapon for operation by the Royal Air Force.

The Weapon System. In the Bloodhound context, that much-bandied term "weapon system" means a self-contained pattern of strategically disposed launching sites—including the aiming radar guidance as well as the missiles and their ramps—and a selective control system integrated with the country's early-warning radar network. As one understands the scene (so far as Security allows it to be revealed) the early-warning information is computed and passed automatically to the control posts of the batteries in the path of the enemy. The control-post radar, which is of selective narrow-beam type, picks up the target and computes its bearing, height, speed and course. The Bloodhound launchers are automatically swung in the general direction of the target and the missile's radar homing head then picks up the narrow-beam reflections from the target. The computing devices in the controlling radar assess the target and automatically fire the correct number of missiles—the guidance, it is claimed, can distinguish between one aircraft and two flying in close formation—when the enemy is in a position from which escape is impossible.

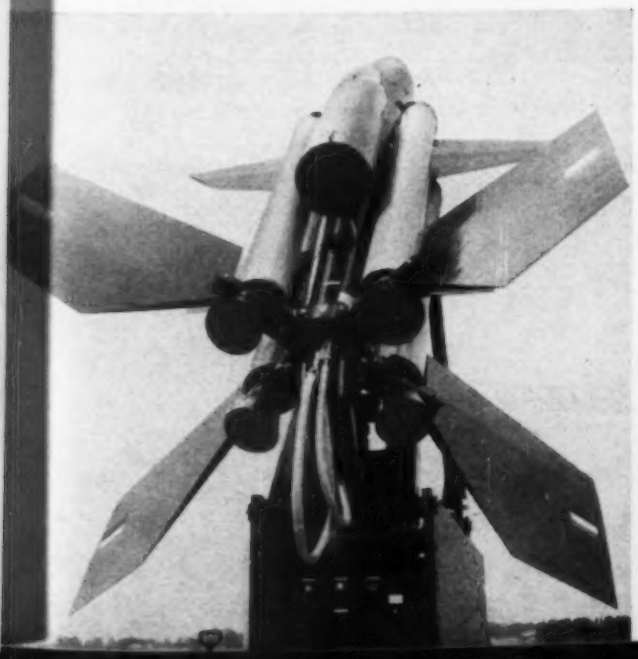
The Ferranti guidance fitted to the Bloodhound is known as S.A.H. (semi-active homing) because it is activated by the directional radar beam from the ground, after which the individual missile-borne equipment does the rest. It may be assumed that each Bloodhound is automatically locked-on to its target. During its attacking flight the computing equipment in the missile's radar head sorts out the movements of the target into an ever-correcting collision course through the flight controls of the airframe. It is claimed that, however violent the enemy pilot's evasive action, the missile will always select the optimum heading for interception in the minimum possible time.

It is known that S.A.H. guidance is susceptible to "glint," the electronic term for false-value reflections caused by different materials and shapes in the target, or by attitude changes in the beam-receiving aerials of the weapon. As Bloodhound can differentiate between single and close-formation aeroplanes, it would appear that Ferranti have advanced far in the suppression of this trouble. There is, of course, the question of emission by the target of "window"—or whatever its modern equivalent may be cover-named—to confuse the weapon; but again, as Mr. Masefield said, "to countermeasures there are counter countermeasures."

And that is just about all that can be said about Bloodhound's guidance. Ferranti were pioneers of printed circuitry in this country and displayed some extremely neat transistorized and printed components at Farnborough last year. When the missile and launcher were shown at Filton last week, every tiny feature of the guidance was conspicuously absent.

The Airframe. As an aircraft, Bloodhound is intensely interesting, both aerodynamically and (as far as one can make out) structurally also. It is really a high-supersonic aeroplane in miniature, certainly capable of more than Mach 2.0, since this is only the beginning of the ramjet's high-efficiency zone.

The outstanding feature is the two-axis control system, using independent variable-incidence wings and a fixed tailplane. This novel departure from the conventional Blériot principle is of supersonic significance. It means that the design takes cognisance of the poor L/D obtainable in supersonic airflow and makes a step toward—or perhaps even past—the *canard*, wherein pitch control is obtained by an up-load on the nose instead of a down-load on the tail. In the case of the bird-like Bloodhound the necessary change in total lift-force for climb and descent is obtained directly by variation of wing incidence, the tailplane being a stabilizer pure and simple. The alteration in downwash on the tail—which is, of course, mounted in the plane of the wing—may well tend to cause over-control, and one feels that



A striking rear view, emphasizing the stabilizing fins on the four large boost motors. The propelling nozzles are in all cases blanked off.

BLOODHOUND . . .

it would require the rate-sensing capacity of an autopilot to meet the situation.

Once the principle of movable wings has been accepted, their differential operation is a foregone conclusion. In a missile their advantages are considerable. Essentially, the whole power-pack and operating mechanism can be grouped in the middle of the aircraft, thus avoiding the necessity for external linkages to tail or nose guidance surfaces.

The process of thinking by which this original configuration was reached must have been somewhat this way. Symmetry is highly desirable in a missile, to ease control and to reduce sensitivity to attitude. In the case of a rocket, two-plane symmetry is a "natural" with the small nozzle easily accommodated in the tail of the body. The larger-diameter ramjet is more of a problem: to obtain optimum efficiency, the direct approach is essential for air intake and jet outlet —so the ramjet must be mounted clear of the fuselage boundary layer. There are several possibilities, such as the wing-tips, but that chosen for the Bloodhound is about as neat as it is possible to imagine.

From this follow two factors. The side area of the missile body plus that of the two Thor ramjets is sufficient, when suitably disposed about the c.g., to provide full static and dynamic stability in yaw, without the need for any fins. Steering is, therefore, entirely by roll and pitch.

The main planes have thin double-wedge aerofoils, with sharp leading and trailing edges; the line of maximum thickness is at about 45 per cent of the mean chord and, according to a Bristol drawing, is swept back 5 deg. The taper is almost equal on leading and trailing edges, but is disguised by the cut-back "Mach angle" tips. (It may be recalled that the Miles M.52 supersonic project, "axed" in 1947, had just this form of wing tip.) The wing tapers in thickness from root to tip, the latter having a maximum depth of about an inch. The all-moving surface—it is pivoted about a tubular spar just aft of the mid-chord point—is known to have excellent anti-flutter and supersonic control characteristics.

The tailplane is a "flat plate" with leading- and trailing-edge wedges and of constant chord and thickness. As in most supersonic fins of this shape, the wedges are inversely tapered, i.e., the angle is flatter at the root than the tip. Maximum thickness is about an inch.

The forebody, over half the length of the vehicle, is truly cylindrical behind the sharply pointed ogival nose. The afterbody is a fructum, tapering at the tail to half its base diameter.

The mounting necks of the Thors vary in detail between the missile shown, photographs and the Bobbin RJTV displayed at Paris. In the round shown at Filton the forward part was a box structure, the rear simply a vertical plate on the centreline. At the forward end was a projecting cylindrical ram-air scoop. It may be recalled that two items shown by Bristol at last year's S.B.A.C. Display were a ram-air hydraulic pump and a ram-air fuel turbo-pump.

It is natural to compare the Bloodhound aircraft with the other known ramjet SAM, the Boeing IM-99 Bomarc—particularly in view of the technical agreement between the companies. It would appear that Bristol obtained (mainly) ramjet operating know-how from America, but this saved something like two years in development time. It is noticeable, too, that both missiles have the distinctive cut-back wing-tips. There, however, all resemblance ends, for the Bomarc has a near-delta high wing with all-moving tips, a fin and rudder, under-slung ramjets and integral booster rocket.

Power Units. The Thor ramjet is fairly well known. It is, however, worth pointing out that the centrebodies in the accompanying photographs are "security dummies": they would indicate a speed of Mach 4—if they did not choke the intake! Fabricated, mainly by welding, from 18-8 commercial stainless steel, the Thors are quite roughly finished externally, except for the intake lips, which are precisely finish-ground.

The arguments for the ramjet as a supersonic powerplant are fairly familiar, but a few points made by Mr. Nedham are significant. Kerosine was chosen for the Thor to give safe handling, but wide-cut or other hydrocarbon fuel would work as well. A fully automatic, pressure- and temperature-compensated stoichiometric mixture control with an override gives, it is claimed, easier thrust control than can be obtained with a rocket. The rocket take-off boost and the ramjet make "a happy combination," since it can be accelerated well into the economical operating régime. The most efficient speed zone is about Mach 2.5, in which a practical pressure ratio is about 15 to 1. The ramjet's fuel consumption is about one-sixth of the propellant consumption for a rocket missile of equal capability. A curve shown suggests that below a 20-mile range the rocket gives the lighter vehicle.

Structure. As far as external examination can show, the Bloodhound is a fine piece of expendable engineering.

The body appears to be of thick-skinned anodized light-alloy construction, with some riveting but with the sections assembled by close-pitched mushroom-headed screws. Bristol's known use of Redux-bonding suggests that this might be used for internal stiffening —of which there is little rivet-line evidence. The glass-fibre ogival nose-cap—which must have posed immense structural and electronic problems—is attached to a welded cylindrical metal section, and there are fourteen external strakes where the latter joins the forebody. These strakes are closely set above and below but absent at the sides (i.e., the structure has maximum reinforcement in the line of the pitching moment) and obviously hold quick-release fasteners.

The wing is fabricated; knowing that Bristol have worked extensively with Durestos, one might hazard a guess that it is filled with this material. That it certainly has an internal structure is revealed by nine spanwise and five chordwise rows of rivets. The wing-tip of the Filton model appeared to be filled with multi-ply. Structure of the tailplane, and of the booster fins, is similar, the latter showing clear evidence of spot welding of skin to structure. The tailplane halves are attached by a spigot spar fitting to a sturdy mounting ring let into the main body.

Launching Equipment. Arrangement of the quadruple concentric boosters is simple. Each ten-foot case is fitted with a massive machined thrust-ring at its base and a ring-bracket with a W-shaped foot at its conical nose. The thrust-ring has pinned to it the fin and is itself attached by two pins to two forks on a central mounting ring, which fits round the tail bulkhead of the missile body. The front bracket has two curved lugs that slide under fore-and-aft lugs on the body.

The slope of the afterbody of the missile means that the boosters have an outward cant of 3 deg, but to aid separation there are two tiny trim vanes (about two inches square) attached to the front ring-bracket of each booster. The action (confirmed by a film) is that, at burn-out, the cessation of thrust causes the booster assembly to slide back a couple of inches, when the nose brackets are released and the cases hinge outward (like an umbrella), to form a cross and be whipped away by their high drag. This umbrella action is the reason for the cut-away trailing-edge roots of the rectangular booster fins, which are necessary for clearance.

Rapid assembly is an important factor in a missile, and this booster assembly is put together with one-inch-diameter headed pins, locked in place by "hairpins" on the castings which slip into annular grooves in the pin-heads.

The launching angle of 45 deg is fixed, but the turntable is hydraulically operated and closely resembles that for a gun. There is no aircraft practice here; it is sturdy, weatherproof shipyard stuff, although it is worth noting that the support frame is made from box girders formed by welding two steel channels face-to-face—a fairly common aircraft jig practice. The lower end of the supporting cradle has a hydraulic raising and lowering ram, while the truss supporting the upper end has triple hinge-knuckles, which are manually locked by removable pins.

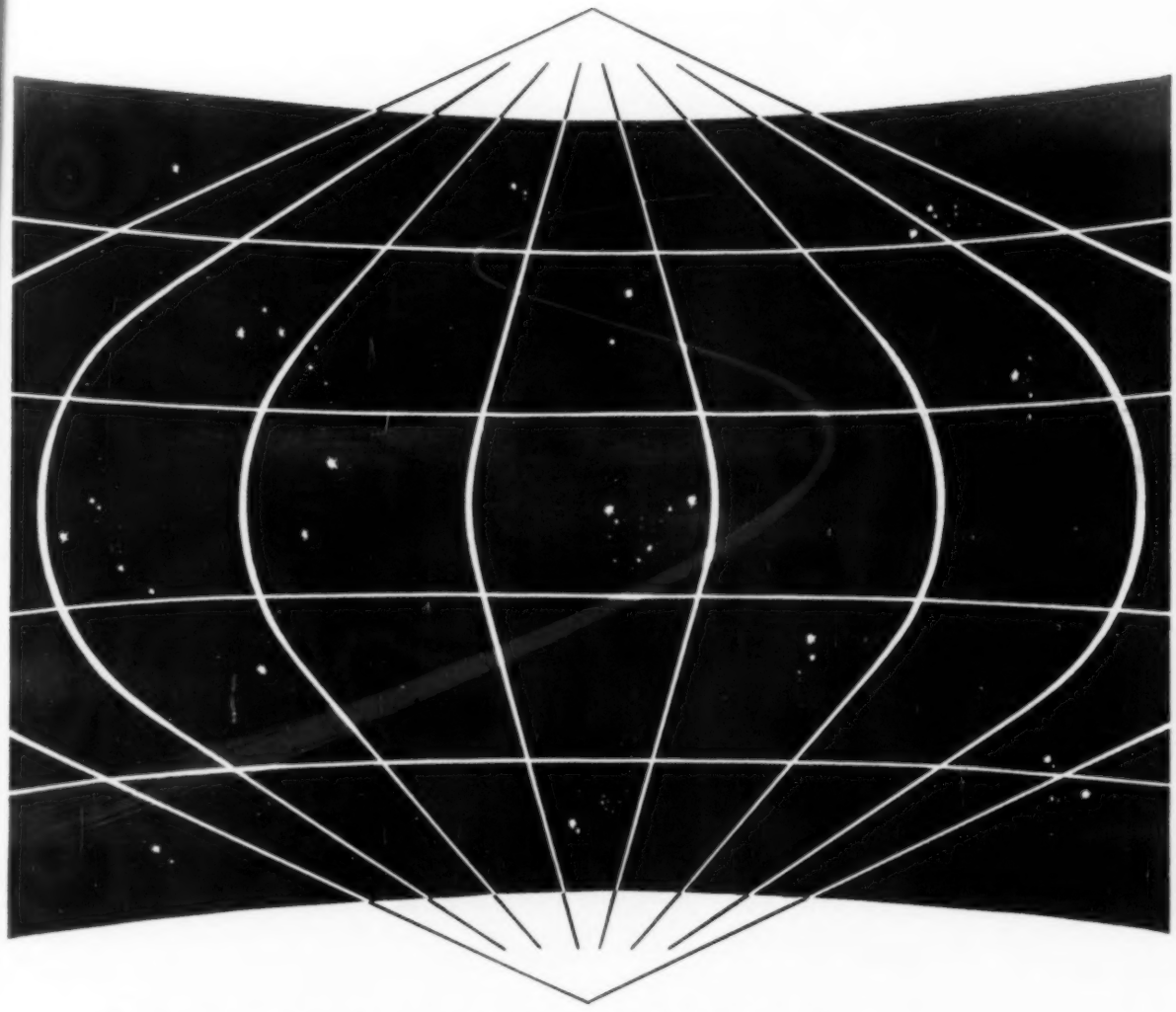
Armoured leads to a screw "breech unit" at the base of the launcher connect to the self-sealing couplings in the tail of the missile. There are high- and low-pressure hydraulic supplies, plus a gyro air-supply—the gyros coast after launching. A multiple electric connector—about 6in × 3in—under the tail is palpably that for all services. This connector is surrounded by a rubber shield on the principle that the Bloodhound is an all-weather weapon which may stand at the ready for days on end.

Bristol Aircraft, who have been given M.o.S. permission to offer the Bloodhound system to Commonwealth and NATO air forces, refer to it as an un-manned VTO fighter requiring no aerodrome. The launcher is not much more than six feet in diameter and obviously lends itself to mounting in dispersed, easily camouflaged bases. One photograph shows how small the trailer is in relation to a Land-Rover —perspective distortion in this picture over-emphasizes the size of the booster fins.

J.H.S.

Dimensional Data: Span, 9ft 3in; length, 22ft 2in; body diameter, 1ft 9in; ramjet diameter, 1ft 3.75in; ramjet length, 8ft 4in; tail span, 4ft 8in; tail aspect ratio, 1·6; wing area (approx) 24.4 sq ft; wing aspect ratio 3·5.

An indication of the mobility and relatively light weight of Bloodhound is afforded by this picture of the weapon being towed by a Land-Rover.



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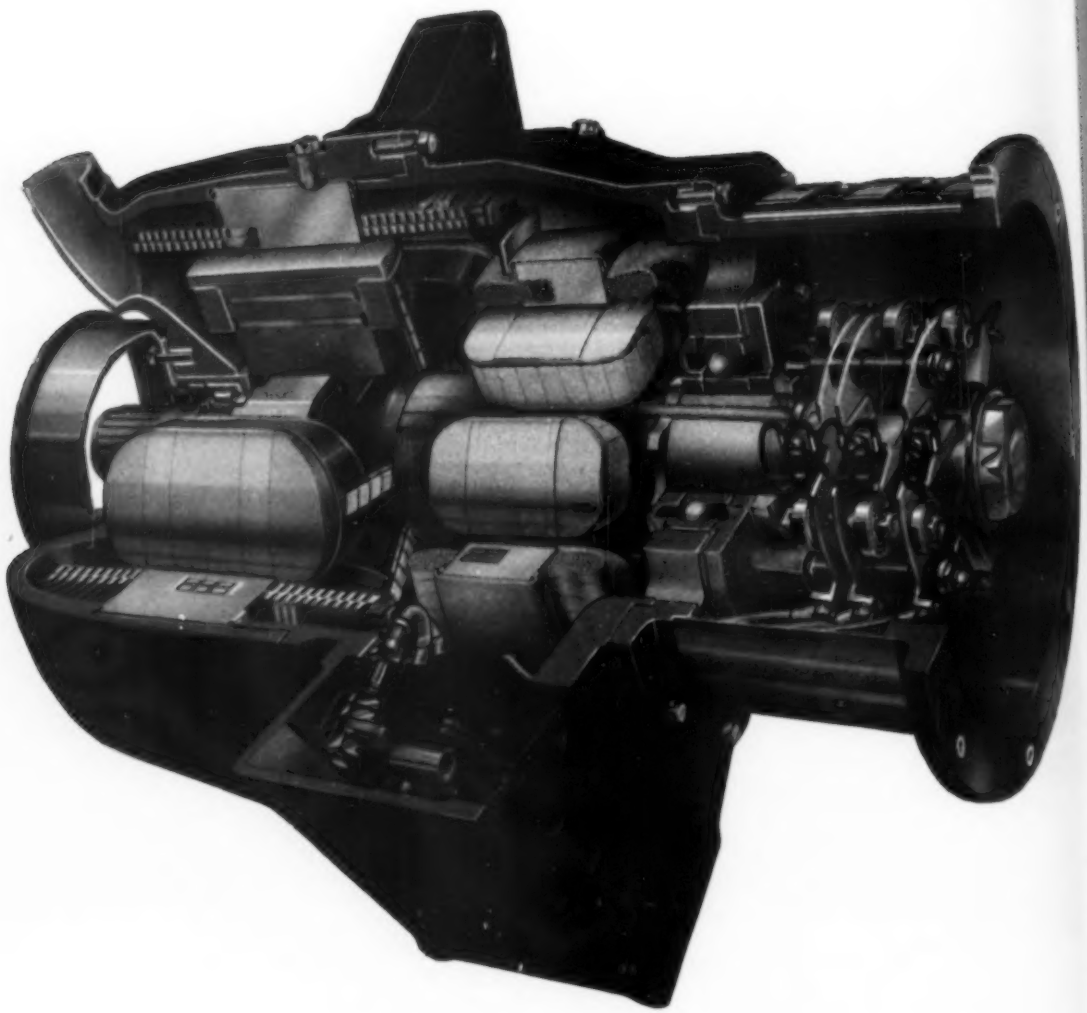

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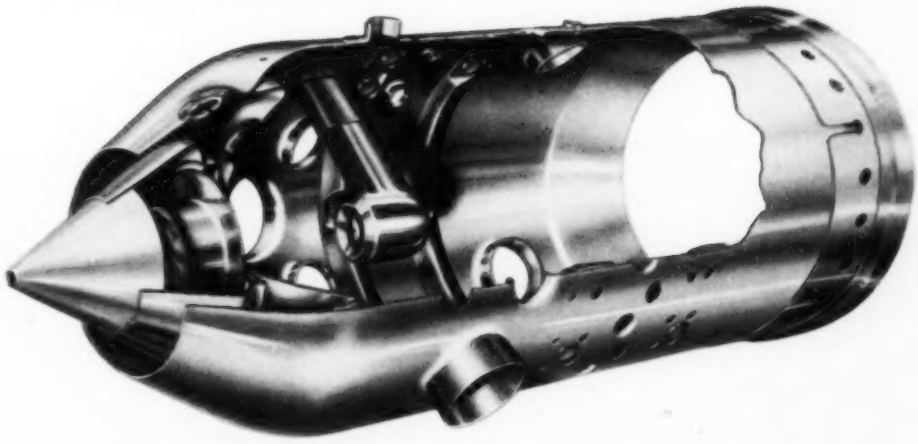

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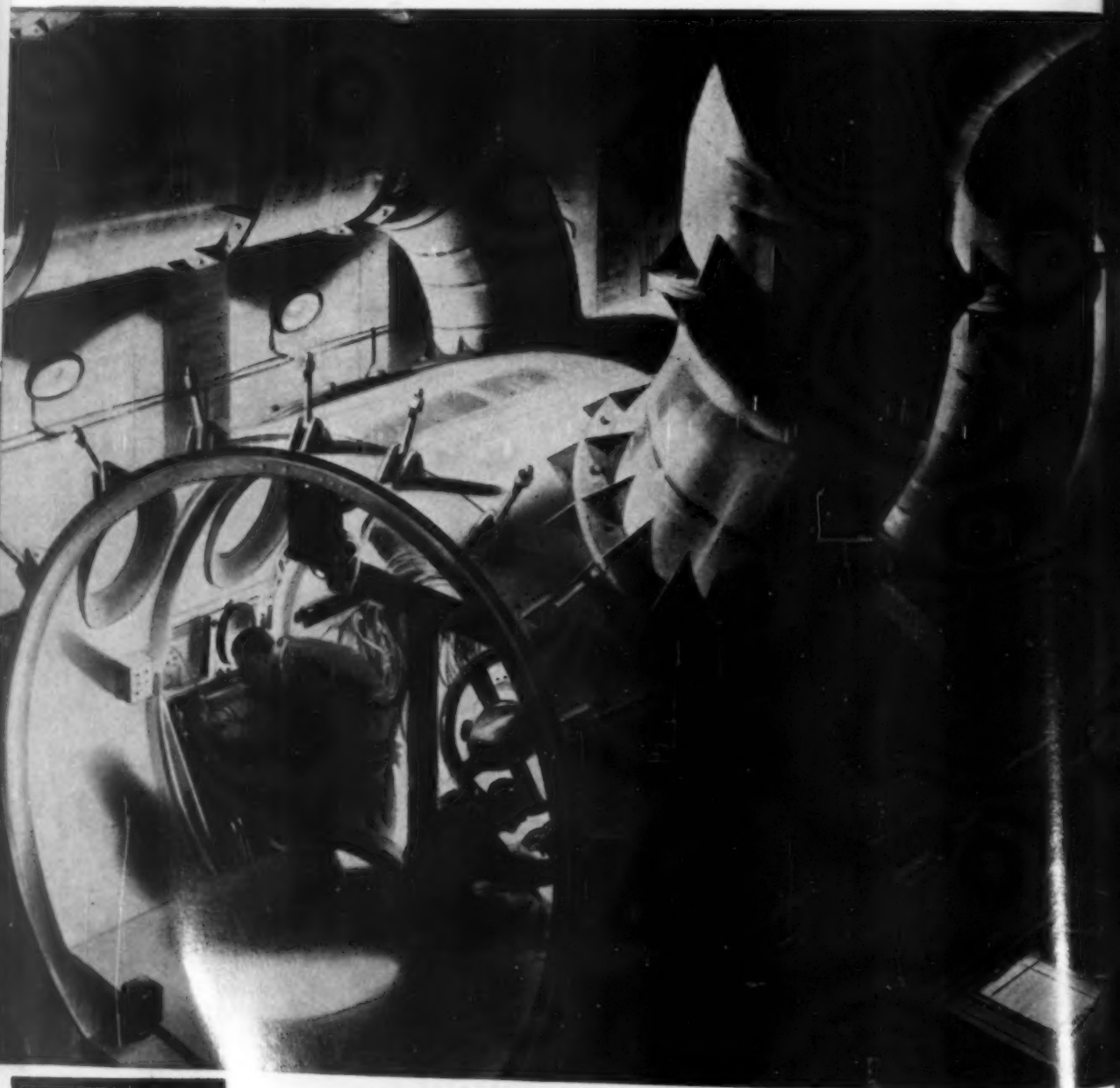


CAREERS *Many fine opportunities exist at ARMSTRONG SIDDELEY MOTOR*

Write to: Technical Personnel Manag

BRITISH AIRCRAFT 1957

A "Flight" survey of civil, military, and research aircraft under development, in production and in service. Data for the various types are presented in tabular form on pages 369-370. Engines are reviewed on pages 331-339, and missiles on pages 328-330.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

Baginton, nr. Coventry. Telephone: Tollbar 2261

Sea Hawk. Eloquent of the handling qualities and sturdiness of this dainty-looking carrier-borne fighter/bomber was its demonstration at last year's S.B.A.C. Display. Loaded with two 500 lb bombs, it was additionally armed, to starboard, with two tiers of two 60 lb rocket projectiles, and, to port, with two tiers of three 3in R.P.s. Moreover, inboard of the bombs, were two 75-gal tanks; and the four 20 mm guns were, of course, in place.

Notable Sea Hawk news of the past year has been the confirmation of Germany's order for 68 Mk 100s and Mk 101s—a contract which followed an order placed by the Dutch Government some months earlier for 30 generally similar machines. The Mks 100 and 101 will be basically identical with the Fleet Air Arm's Sea Hawk FGA.6, but with internal modifications to meet German requirements. Like the FGA.6, they will be powered with a Rolls-Royce Nene turbojet, delivering considerably in excess of 5,000 lb thrust.

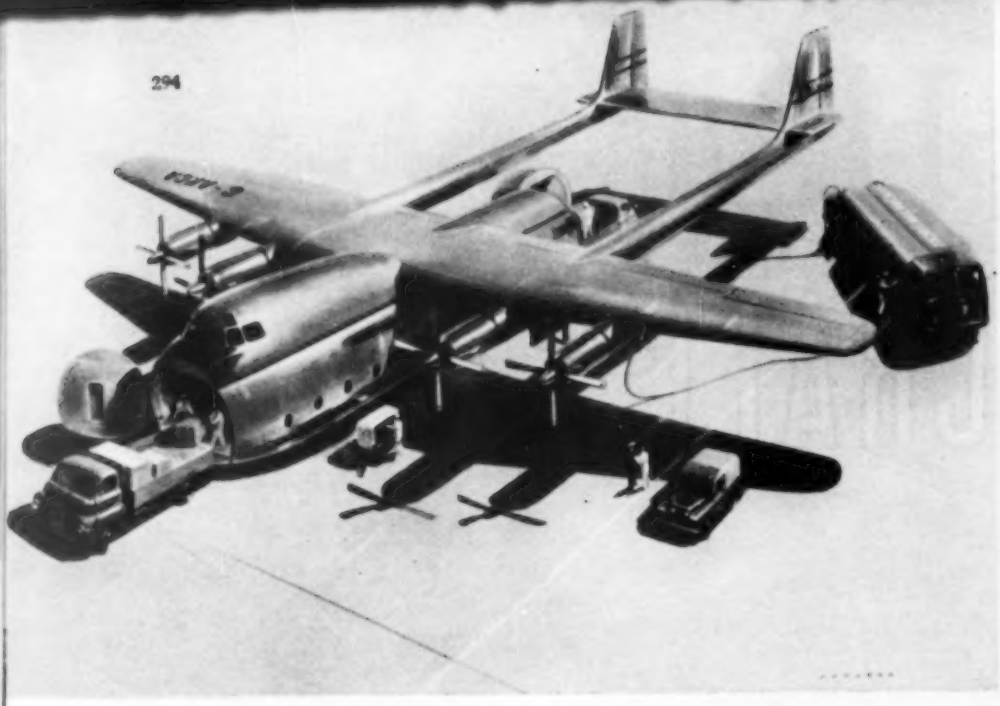
In Fleet Air Arm service various marks of Sea Hawk have continued to give an excellent account of themselves, and in several respects have proved superior to comparable swept-wing machines of foreign type.

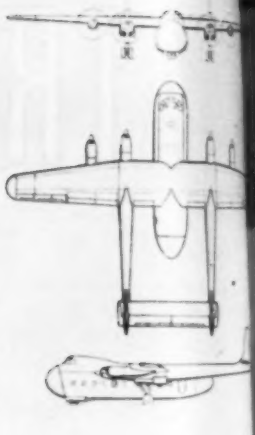
By no means a discreditable record for a machine designed about twelve years ago.

Freightercoach (AW.650 Series). With the AW.650 series—"designed to meet the need for a modern, adaptable transport specially tailored for the growing volume of freight and aircoach traffic in all parts of the world"—the Hawker Siddeley Group are once again offering a challenge in the civil-aircraft market. Sir W. G. Armstrong Whitworth Aircraft, Ltd., the company principally concerned, has a long and very creditable history of civil aircraft development (Argosy, Atalanta, Ensign, Apollo).

Six derivatives of the new design are foreseen—the AW.650 Freightercoach with four Rolls-Royce Darts; the AW.651 Freightercoach with two Rolls-Royce Tynes; the AW.660

...ery, lant ... **Rolls-Royce Nene**
...n 39ft
...gth 40ft
...ve and right, Sea Hawk FGA.6.





military transport (four Darts); the AW.661 military transport (two Tynes); the AW.670 car ferry (four Darts); and the AW.671 short-stage "bus" (four Darts). Production of ten AW.650s is already in hand, and the first flight is scheduled before the end of 1958.

A twin-boom layout, in conjunction with nose and tail doors, provides exceptional freedom of loading and unloading. The pressurized fuselage of the Freightercoach is roughly of circular section and offers an unobstructed volume for all kinds of useful load. In the standard arrangement there are 77 passenger seats at 34in pitch, with toilet and galley facilities for medium stages. The AW.670 car ferry will take six cars and 30 passengers, and the AW.671—the "bus" of the family—will seat up to 130 people on short sectors.

The wing structure is based on that of the Avro Shackleton, so that the same spar-boom milling machines are available, and the company already has an exact estimate of such factors as performance and fatigue life. High-lift flaps will be fitted.

Powerplant ... Four Rab-h Dart R
Span ... ...
Length 9
Gross weight 6
Typical cruising speed 276 m

Artist's impression and three-drawing show A.W.650

AUSTER AIRCRAFT, LTD.

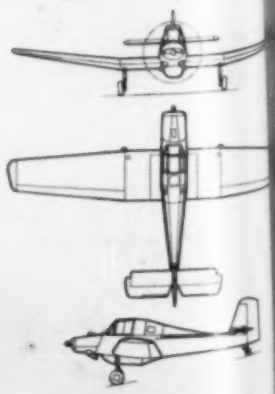
Rearsby Aerodrome, nr. Leicester. Telephone: Rearsby 321

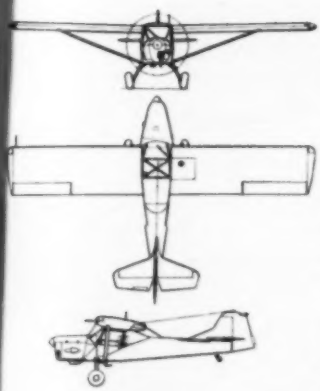
Agricola. In the design of this challenging new agricultural aircraft the Auster company has aimed to reconcile performance with load-carrying capability and exceptional measures for pilot safety. For ease of repair the fuselage is of welded tubular-steel construction, and aft of the hopper-filling trunk is a two-seat passenger compartment, in which groundcrew may be transported. The control cables to the tail unit are external but a tough nylon covering protects them from the action of phosphate and all known chemical insecticides.

The aircraft can be supplied in three versions: (1) with hopper only for top-dressing and dusting; (2) with spray tanks only, i.e., suitable for spraying; (3) in a multi-purpose arrangement, with both spray tanks and hopper. The capacity of the spray tanks is 144 gal.

It was recently learned that the company has made intensive tests to ascertain the flow

Powerplant ... ... Continental O-470
Span 3
Length 2
Gross weight 3,6
Economic cruising speed 101 m



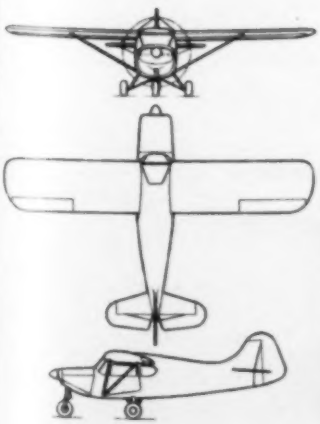


Powerplant	...	**Blackburn Cirrus Bombardier 203**
Span	... ...	36ft 5in
Length	... ...	23ft 8¼in
Gross weight	... ...	2,125 lb
Max. speed	... ...	127 m.p.h.

Three-view drawing and photograph above show A.O.P.9.

Powerplant	...	**Continental E185-10**
Span	... ...	36ft (alternatively 32ft)
Normal gross weight	...	2,250 lb
Max. speed (short span)	... ...	142 m.p.h.

Artist's impression at top right and drawing below show Atlantic.



characteristics from the hopper of a variety of materials, including superphosphate in dust and pellet form, basic slag, gypsum, wheat—and gravel (though this last was used only to simulate full loads for prospective customers making trial flights). Tests have also been made with filler dust, used as a diluent to obtain very low rates of chemical deposit per acre without reducing the actual mass flow from the hopper to impracticably low levels.

Atlantic. The absence of pre-publicity for this new aeroplane renders its first appearance (on the Auster stand) an occasion of particular interest to private owners. The makers emphasize that the design is entirely new. The engine is a Continental E185-10 driving a Hartzell variable-pitch propeller of 7ft diameter. Though all three wheels of the nosewheel undercarriage are of the same size as those employed on current civil Austers, the cabin is much larger and seats four. The two doors measure well over 3ft across and the two front seats are independently adjustable.

Of the new machine the makers add: "Smoking is permitted and ash trays and a cigarette lighter provided. The cabin floor is carpeted and the cabin itself is air-conditioned, both heating and cooling ducts being fitted. An entirely new instrument panel has been designed similar in style to average motor-car facia panels. Most of the roof Perspex fitted to current civil Austers is absent on the Atlantic as it has been found unnecessary and has proved to be far too hot in tropical climates; the only upward vision is above the pilot, where it is needed. Special attention has been paid to sound-proofing the Atlantic and it will prove to be far quieter than similar lightplane types (the removal of the larger expanse of top cabin Perspex goes a long way to providing quietness in flight). The nosewheel undercarriage is damped by three Lockheed oleo legs. The nosewheel is attached to the engine mounting frame and, of course, this type of undercarriage provides excellent visibility over the nose on the ground whilst taxying. The aircraft shown on the Farnborough stand will be the Windsor Deluxe version. This will be the best equipped version of the Atlantic available. A less luxurious Atlantic will be produced at a later date and this will be called the Winchester."

A.O.P.9. This is the standard air observation post in British service. It is uncommonly sturdy and sufficiently roomy for it to undertake the tasks of casualty evacuation, light liaison, supply- or mail-dropping, cable-laying, photography or light freighting. The 180 h.p. Blackburn Bombardier engine drives a high-efficiency, fixed-pitch, metal propeller, and cruising consumption is as low as eight gallons per hour. A cartridge starter is fitted.

The normal A.O.P. crew consists of a pilot and an observer, the latter having a seat in the rear of the cabin which faces forwards or aft as required. The pilot's position has quickly detachable armour plate. Provision is made for a third seat, beside the pilot's. Entry to the cabin, even in Arctic clothing, is claimed to be a simple matter, for three wide doors are

Auster Alpine (for description see over).

fitted. Field of view is exceptional, as are the characteristics of the undercarriage which, in the terms of the maker's claim, allow "rough fields, rutted cart tracks, or sodden jungle strips" to be used as landing areas. Each undercarriage leg is a solid forging and utilizes a special shock-absorber capable of withstanding a descent rate of 9ft/sec.

Alpine Profiting from their experience with the Autocar and Aiglet models, particularly in overseas service, Auster Aircraft have produced this "amply powered and crisply controllable" three-seater. A particularly appealing feature is the extra width (4½in more elbow room) in the cabin. Quick conversion for freighting, glider- or banner-towing, spraying, and other alternative rôles, is possible. A member of *Flight*'s staff reported as follows after an air test: "[The Alpine] has very much better handling characteristics (than American equivalents previously mentioned), a performance tailored for rough work and a simplicity which offers low maintenance costs and really worthwhile flexibility of load and utilization. I was more impressed by the Alpine than by any other Auster type to date."

AVIATION TRADERS (ENGINEERING), LTD.

15 Great Cumberland Place, London, W.1. Telephone: Ambassador 2091

Accountant In *Flight*'s detailed description of this promising new turboprop airliner (issue of July 12) it was remarked that, for a constructional and operating group—and a shrewd and successful one at that—to turn its attention to aircraft design was sufficiently unusual to excite a good deal of comment. Much interest in the progress of the aircraft has, indeed, been displayed both at home and overseas.

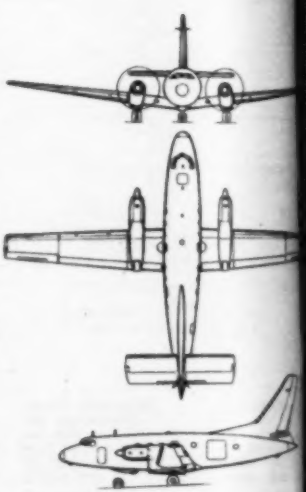
When the Accountant was first conceived it was broadly a DC-3 replacement that the company had in mind, although they realized then that only certain features of the evergreen Douglas, specifically long life, ruggedness and a degree of adaptability, required perpetuation. Performance, safety and operating economy were obviously open to great improvement, particularly with the installation of Rolls-Royce Dart turboprops.

Although a 40-seater version of the Accountant is in prospect (this would be competitive with the Fokker Friendship), the first layout is for a version with 28 seats or fewer which could readily be adapted as a freighter or as a mixed-traffic aircraft. Such a scheme, it was felt, would have a direct appeal to present DC-3 operators, and particularly those who do not contemplate expanding during the next few years to a condition where more than about 22 seats filled per trip would be required to obtain a break-even load factor. The executive transport market has also received particular attention.

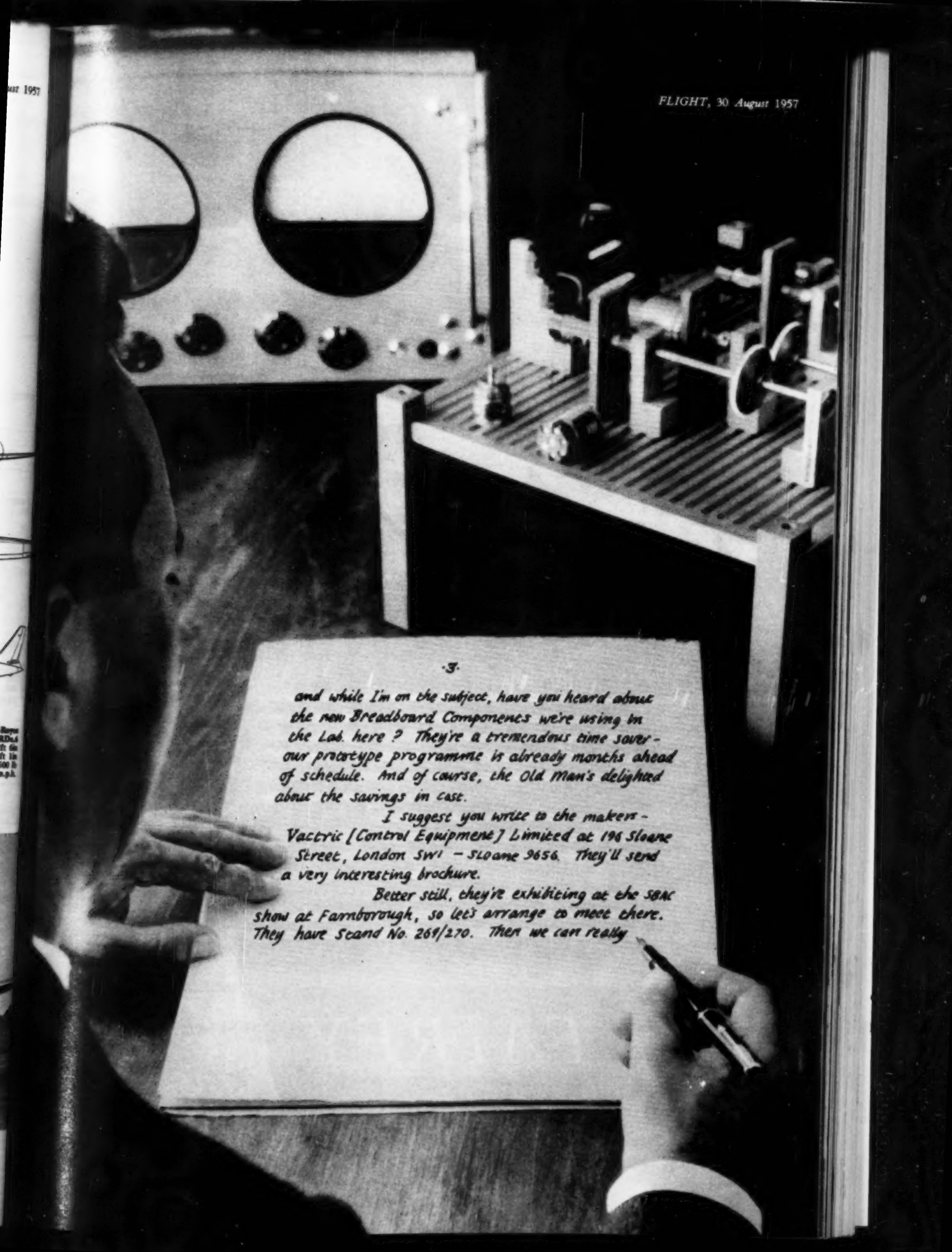
The prototype fuselage, which will not have pressurization equipment installed, is built on the tension-skin method of construction pioneered by Aviation Traders. This will not be continued in subsequent aircraft as additional time and manpower-absorbing development would be required to perfect it, and recent careful studies of more flexible methods of construction have shown that no weight penalty is necessarily involved.

The undercarriage scheme is uncommon. Retracting forwards into the nacelle "step," the gear is short and sturdy. Twin wheels are fitted to the main legs and are controlled by anti-skid units. The twin nosewheels protrude slightly in the retracted position and should protect the nose fuselage if a wheels-up landing has to be made. Particular attention has, in fact, been given to safeguarding the aircraft in non-catastrophic emergency landings.

Now being constructed are the second and third aircraft, embodying 5.5 lb/sq in cabin pressurization, inflatable chordwise de-icing boots, and provision for either a British or an American weather radar. An extended canopy fairing will be fitted to these machines, and the characteristic kink in the top decking of the prototype will disappear. (See three-view drawing.)



Powerplant	...	Two Rolls-Royce Dart RDa.6
Span	...	82ft 6in
Length	...	62ft 1in
Gross weight (initial)	...	28,500 lb
Mean cruising speed	...	294 m.p.h.

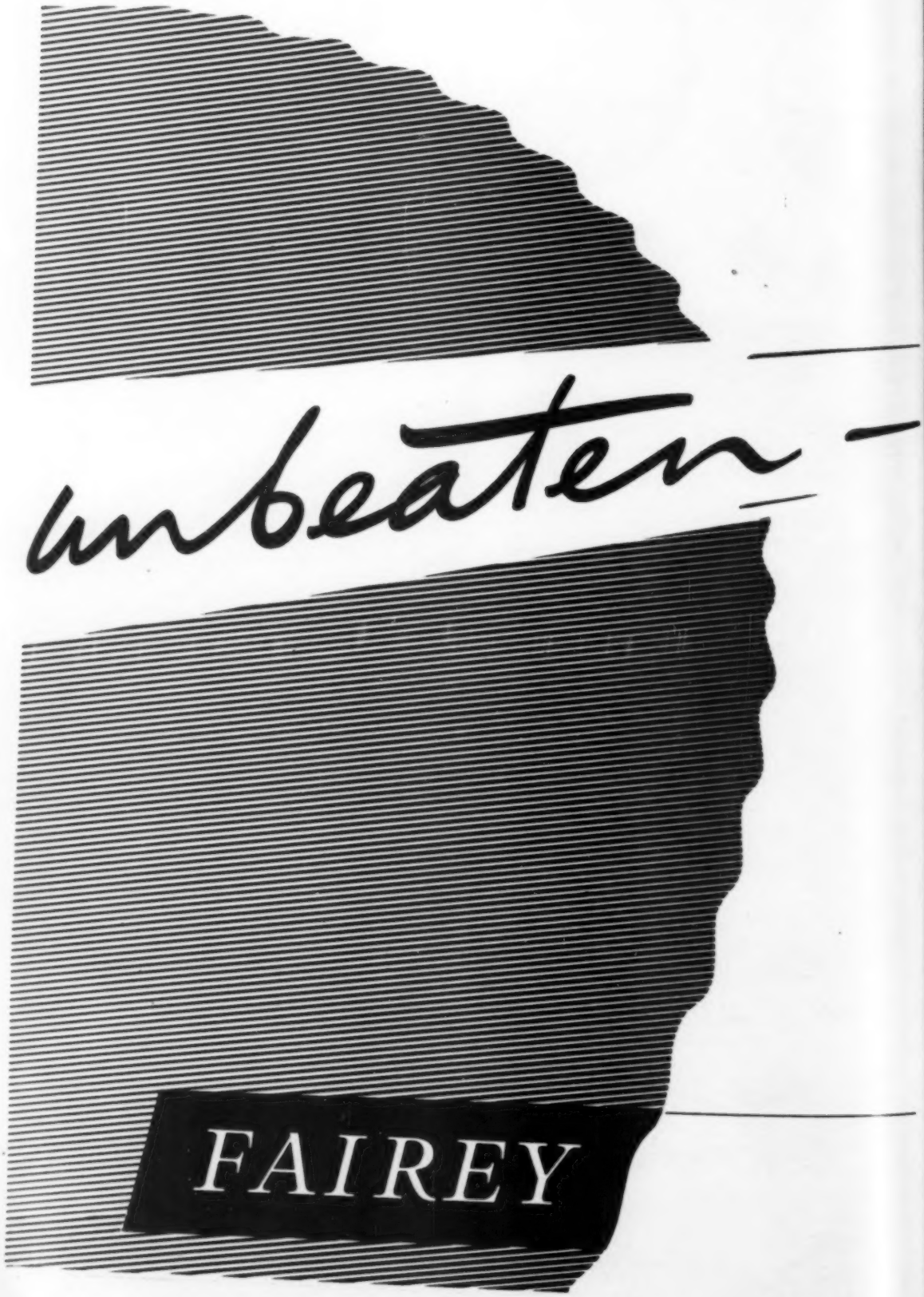


-3-

and while I'm on the subject, have you heard about the new Breadboard Components we're using in the Lab. here? They're a tremendous time saver - our prototype programme is already months ahead of schedule. And of course, the Old Man's delighted about the savings in cost.

I suggest you write to the makers - Vactric [Control Equipment] Limited at 198 Sloane Street, London SW1 - SLOane 9656. They'll send a very interesting brochure.

Better still, they're exhibiting at the SBAC show at Farnborough, so let's arrange to meet there. They have Stand No. 269/270. Then we can really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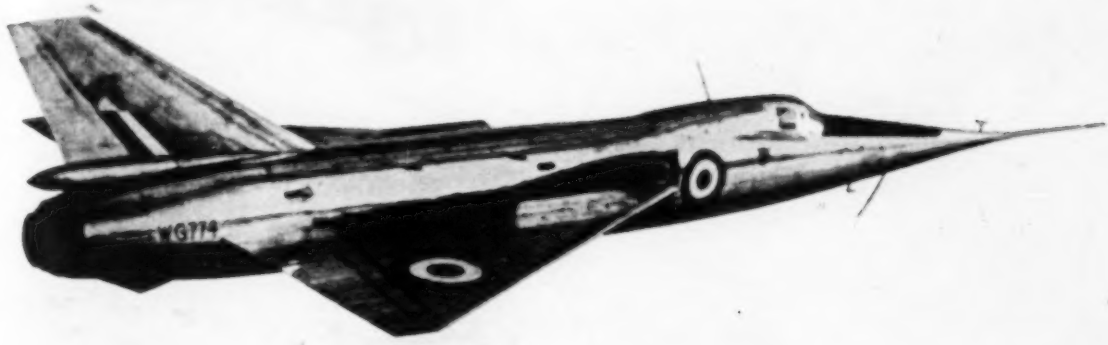

For a year and more the brightest jewel in the 'triple crown' of world speed records held by Britain has been the Fairey Delta 2. On March 10th, 1956, it flew at 1132 m.p.h. under F.A.I. observation, and became the first aeroplane officially to exceed 1000 m.p.h. This World Absolute Speed Record still stands.

In 1956 Fairey flew the fastest aeroplane: in 1957 Fairey will fly the Rotodyne, largest transport helicopter in the world.

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Twin Pioneer

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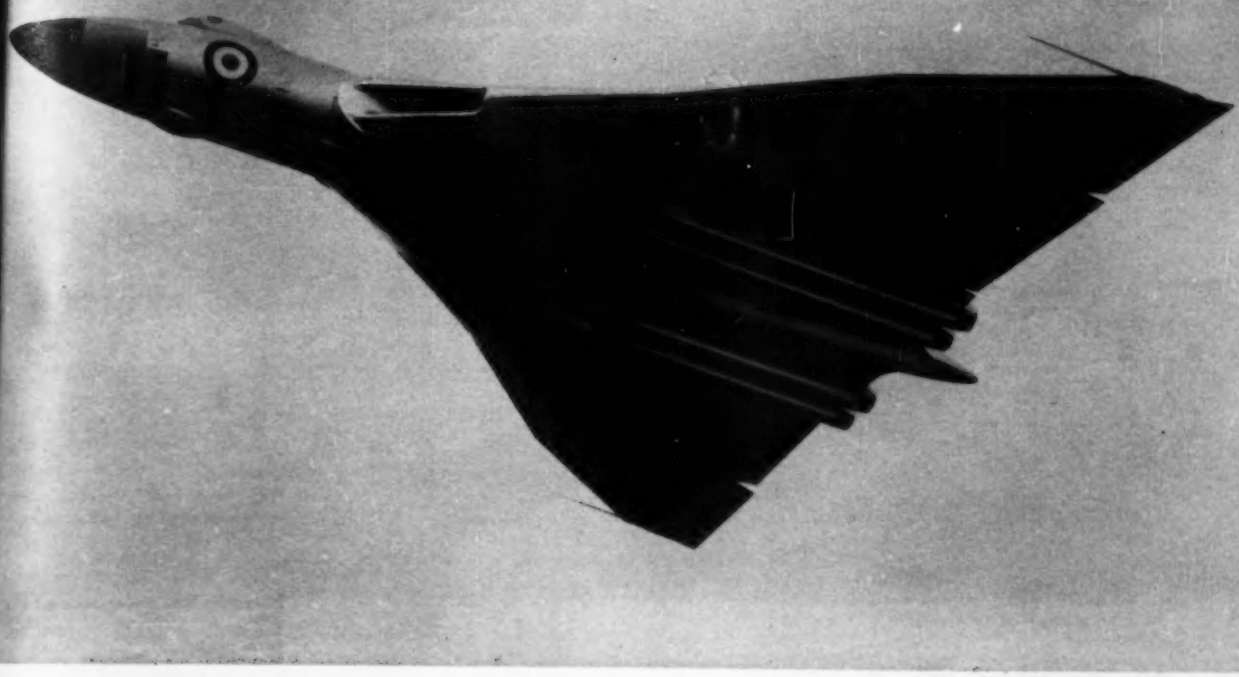
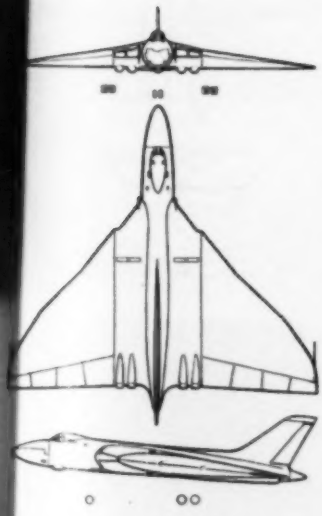


A. V. ROE AND CO., LTD.

Greengate, Middleton, Manchester. Telephone: Failsworth 2020

Powerplant ... **Four Bristol Olympus**
Span 99ft
Length 97ft 1in

Photograph and drawing show Vulcan B.1.



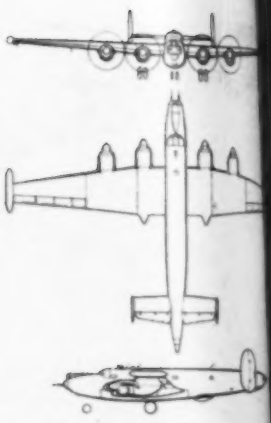
Vulcan B.1 Delta-wing, four-jet V-bombers of this mark are now in service with No. 1 Group, R.A.F. Bomber Command. All are powered with Bristol Olympus two-spool turbojets, and they embody a developed wing leading-edge, with compound sweepback. Characteristic of the Vulcan are the massive powered ailerons and elevators on the trailing edges of the wing; air brakes, of rectangular form, above and below the centre-section; and the absence of empennage and of flaps. The control system is such that, in conjunction with the Vulcan's very favourable wing loading and power loading, an exceptional standard of manoeuvrability is conferred. A Vulcan has already demonstrated, at a former S.B.A.C. Display, its ability to perform upward rolls. As for speed, it is known that readings of Mach 1 have been achieved on several occasions, although the makers do not claim that the Vulcan has ever exceeded the speed of sound. In regard to height, it can only be remarked that Vulcans have frequently flown at levels in excess of 50,000ft, and a recent series of very remarkable photographs—one of which was reproduced in *Flight* of July 12 last—embracing very large areas of Great Britain, are a reminder of potentialities in the photographic reconnaissance role. Conventional or nuclear armament can be carried and the bomb bay is of exceptionally large dimensions. Provision is made for probe-and-drogue flight-refuelling.

It was announced by the Air Ministry a few weeks ago that the R.A.F.'s first Vulcan squadron—No. 83, based at R.A.F. Waddington, Lincs—had won the Laurence Minot Trophy. This trophy is the premier award in the R.A.F. Bomber Command annual bombing competition and is presented to the medium-bomber squadron gaining highest marks for combined bombing and navigation. An official announcement read: "Aircraft were required to undertake cross-country flights of about five hours' duration and make simulated radar bombing attacks from varying heights between 40,000 and 50,000ft. Each aircraft carried an umpire to note any infringements of competition rules. Throughout the competition no aircraft failed to complete its scheduled flight. . . ."

Although all the R.A.F. Vulcan B.1s are powered with Bristol Olympus turbojets, one development aircraft is fitted with Rolls-Royce Conway by-pass engines, and, as this page goes to press, is expected to participate in the S.B.A.C. flying display.

Vulcan B.2 At the moment of writing all that can be said officially concerning this much improved Vulcan is that it will be powered with four Bristol Olympus BOl.6 two-spool turbojets. These units deliver very much more thrust than the earlier Olympus powerplants fitted to the B.1, and it is expected that the airframe will be considerably redesigned in order to reap the fullest benefit of the increased power.

In connection with this development must be mentioned the Avro "stand-off" powered bomb now under development—a weapon which is likely to be employed also by other V-bombers. Guided weapons of this sort are intended for the penetration of heavily defended target areas and represent the half-way point between the free-falling bomb and the complex ground-launched bombardment missile. Ranges of upwards of 100 miles might well be achieved by bombs of this kind, and their speed would render interception extremely difficult.

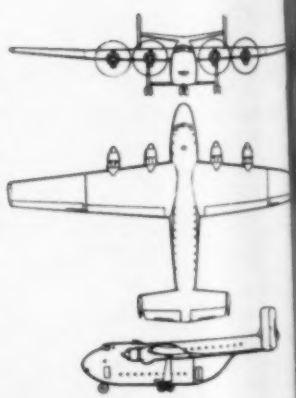


Powerplant Four Rolls-Royce Gelin
Span 120ft 6in
Length 87ft 4in

Photograph and drawing show Shackleton M.R.3.

Powerplant Four Bristol Centaurus 57
Span 162ft
Length 99ft 5in
Gross weight ... ... 143,000 lb
Max speed ... 238 m.p.h. at 5,700ft

Drawing below and photograph at upper right show Beverley.



Shackleton M.R.3 This newest development of the Shackleton maritime-reconnaissance series of landplanes differs from the M.R.2, as operated by R.A.F. Coastal Command, in having a nosewheel undercarriage. Various internal improvements have been effected and a lower noise-level has been achieved—from the crew's point of view an excellent feature in any long-range aircraft. The M.R.3 has been ordered not only for Coastal Command but for the South African Air Force also.

The war load of the Shackleton M.R.2 and 3 consists of bombs, depth charges, sonobuoys or other stores, and alternative provision is made for an air/sea rescue lifeboat. A representative of *Flight* who visited Coastal Command in connection with our special "Royal Air Force" issue (June 28 last) reported as follows: "The Avro Shackleton M.R.2 aircraft with which the Command performs its main role has an endurance which is ample for reconnaissance half-way across the Atlantic. Special assignments require crews to fly their aircraft to almost any part of the world, and only recently No. 224 Squadron, operating from Gibraltar, circumnavigated most of South America on a double-purpose goodwill and training mission. The Shackleton M.R.2 is powered by four Rolls-Royce Griffon engines (it is claimed that height can be maintained on two). A crew of ten includes two pilots, two navigators, five radio/radar operators and one flight engineer. With its high-power radar equipment a Shackleton can search an area of some 200,000 square miles of sea in the course of a single sortie."

BLACKBURN AND GENERAL AIRCRAFT, LTD.

Brough, East Yorks. Telephone: Brough 121

Beverley In a message for *Flight's* special "Royal Air Force" issue the Air Officer Commanding-in-Chief, Royal Air Force Transport Command, wrote: "The Beverley has given an entirely new significance to the term 'air-portability,' as its huge freight compartment literally opens the doors to a vast new range of Service equipment and military stores which hitherto could not have been carried by air. Moreover, this unusual aircraft does not need the sophisticated facilities of a modern airfield . . ."

Three Beverley squadrons have now been formed and the specialist capabilities of these massive aircraft are being developed in exercises and training. Apart from its applications of general freighting and troop-carrying and dropping (with the main loading doors in place) the Beverley has greatly widened the R.A.F.'s scope in the heavy-dropping role. The heaviest load yet released from a Beverley is 29,000 lb of steel plate and other ballast. This was accomplished by means of eight G.Q. parachutes each having a diameter of 66ft.

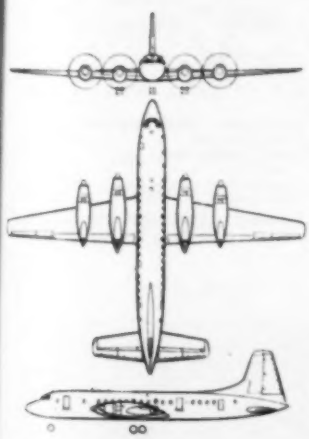
Beverley Development with Rolls-Royce Tynes In a recent address to shareholders the chairman of Blackburn and General Aircraft, Ltd., referred to proposals for the design and manufacture of a version of the Beverley with four Rolls-Royce Tyne turboprops, which could be in service by 1962.

N.A.39 The Admiralty's explanatory statement on the Navy Estimates 1957/58, issued earlier this year, remarked that the Blackburn N.A.39 strike aircraft would have a con-

Beverley (in heavy-dropping rôle).

Powerplant	Four Bristol Proteus 755
Span	142ft 3½in
Length	124ft 3in
Gross weight	175,000 lb
Typical cruising speed	390 m.p.h.

Drawing and photograph below show Britannia 310 series.



siderable range and ability to carry an atomic bomb. It would be "a most formidable" addition to the Royal Navy's striking power. Of this same aircraft the company's chairman has expressed "great hopes" that it will become a most successful aircraft and has remarked that it seems suitable for use with the Royal Air Force, NATO and Commonwealth countries as either a land or ship-based bomber. He went on: "We believe that in its class it will prove to be better than anything else in the world, and it is not without interest that as part of defence aid the United States Government is bearing some of the cost of development of the aircraft and will also provide a large amount of equipment, of a type not available in this country, to assist rapid and effective flight testing."

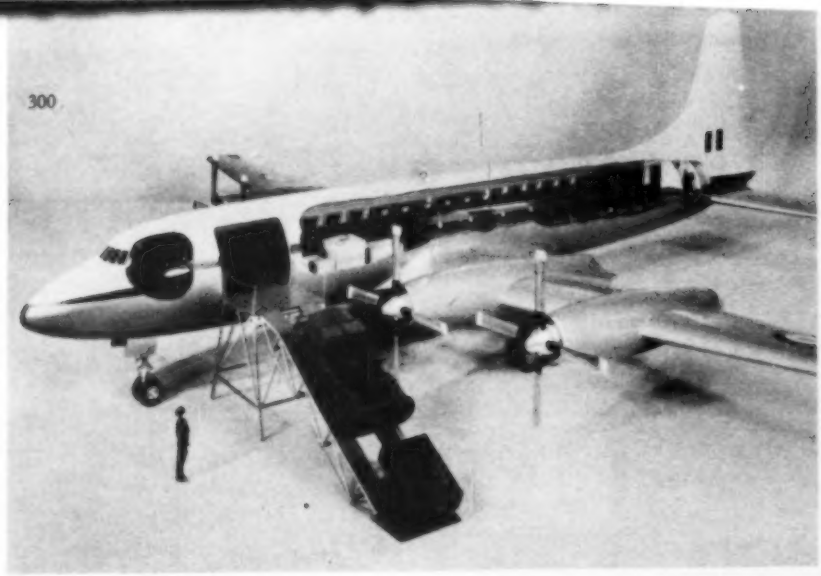
In its first form the N.A.39 will be laid out to meet F.A.A. requirements for a low-level strike aircraft. It is reasonable to suppose it will have two turbojets, and its strength must obviously be very great. In this connection the makers have published a photograph of a special skin-miller designed and built at Brough in less than twelve months. This was developed because there was no machine tool available in Great Britain for the production of some N.A.39 components.

BRISTOL AIRCRAFT, LTD.

Filton House, Filton, Bristol. Telephone: Filton 3831

Britannia 310 Series This is the standard Britannia now being offered on the commercial market, and it is in production for B.O.A.C. (18), El Al Israel Airlines (3), Canadian Pacific Airlines (6), Hunting-Clan Air Transport (2), and Cubana (2). Orders from other airlines are being negotiated as this issue goes to press; in particular there is a requirement for up to 30 aircraft by Trans World Airlines of the U.S.A.

First deliveries of Britannia 310s from the Bristol factory at Filton are soon to be made to B.O.A.C., who expect to put them into transatlantic service before the end of the year.



Left, Britannia 253 (model).

Thus, for the first time in the Corporation's history, B.O.A.C. will be able to offer the most competitive aircraft on the world's richest and most contested route. As further deliveries are made, B.O.A.C.'s Britannia 312s will—according to the airline's present plans—gradually take over all North American services now operated by Stratocruisers and DC-7Cs.

The Britannia 310 fulfils the potential airline requirement for the big-capacity (28,000 lb), long-range (5,000 miles still air) turboprop transport. As such it will compete directly with the Boeing 707 and DC-8—due to enter service in 1959 and 1960.

The development potential of Britannia 310 remains large, and there are plans to fit "supercharged" (i.e. split-compressor) Bristol Orion turboprops in place of the Proteus 755s. Canadair of Montreal earlier this year completed a licence-agreement with Bristol for the production and marketing of an Orion-Britannia development, to be built alongside the Argus maritime-reconnaissance version for the R.C.A.F.; this aircraft will be capable of 440 m.p.h. cruising speeds and improved payload-range performance. Looking further into the future, Bristol can foresee, depending on demand, a market for a thin-wing, lengthened version powered by Orions which will further increase speed and payload-range performance.

The Britannia 310, with its big-capacity fuselage (up to 130 seats) and low operating costs, promises to be the ideal class of transport aircraft for exploiting the "thrift-class" low-fare services due to be introduced next spring.

Britannia 300 Series The 300 Series was originally the medium-range version (with the same tankage as the early 100) of the Britannia, of which seven were ordered by B.O.A.C. These were subsequently released for export; five were bought by Northeast Airlines of Boston, for use (as from December next) on the holiday-route from New York and Boston to Miami. These machines, designated 305, were modified virtually up to 310 standard. The remaining two, 302s, were bought by Aeronaves de Mexico for use (as from October) on the airline's new route to New York.

Powerplant		Alvis Leonides Mk. 73
Rotor diameter	...	48ft 6in
Length (main rotor folded)	... ...	46ft 2in
Gross weight	...	5,400 lb.
Max. speed	... ...	127 m.p.h.

Drawing above and photograph below show Type 171 Sycamore.

BRANCHLINERS

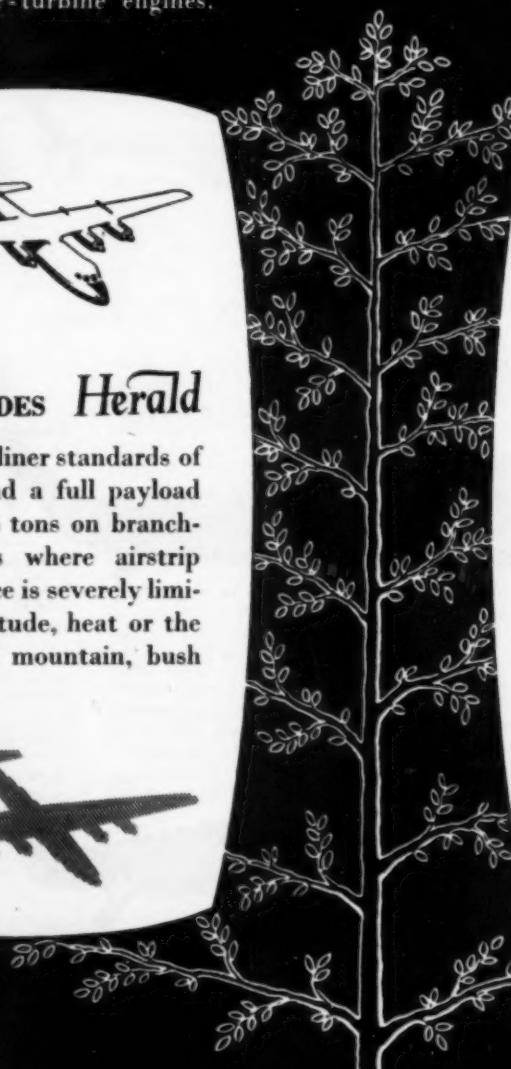
The Herald branchliner is now available equipped with either piston or propeller-turbine engines.

The Alvis LEONIDES *Herald*

offers mainliner standards of comfort and a full payload of nearly 5 tons on branchline routes where airstrip performance is severely limited by altitude, heat or the barriers of mountain, bush or jungle.

The Rolls-Royce DART *Herald*

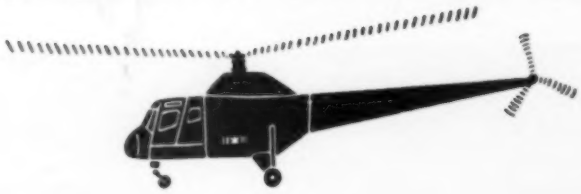
brings the faster cruising speed–275 m.p.h.–of propeller-turbine flight to branchlines where airfield limitations are less acute and where, as a result, the economy of the piston-engined branchliner can be matched.



Apart from the engines and their nacelles, there will be no major structural differences between these two branchliners. They will come from production lines common to both and will be equipped with Leonides Majors or Darts as required.

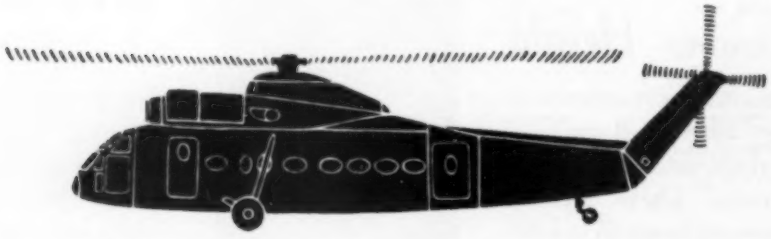
HANDLEY PAGE · RADLETT · LONDON · READING

WESTLAND

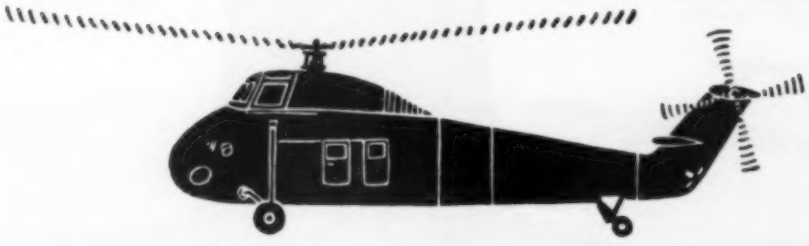


WIDGEON
Carries four passengers or ½ ton of freight

WHIRLWIND
Carries eight passengers or 1 ton of freight



WESSEX
Carries twelve passengers or 2½ tons of freight



WESTMINSTER
Carries forty-two passengers or 7 tons of freight

HELICOPTERS
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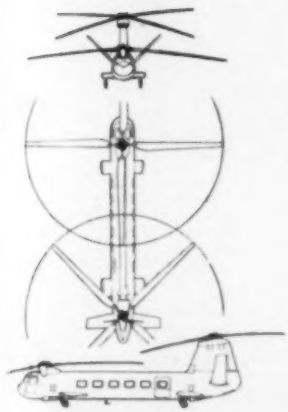


Powerplant **Two Alvis Leonides Major**
Rotor diameter ... 48ft 6½in
Length (rotors folded) 54ft 2in
Gross weight ... 13,500 lb.

Photograph and drawing above show Type 173.

Powerplant
Two Napier Gazelle Series 2
Rotor diameter ... 48ft 8in
Length (rotors folded) 54ft 4in
Gross weight ... 18,000 lb.
Cruising speed ... 138 m.p.h.

Drawing and photograph of model below show Type 192.

Britannia 250 Series These are military versions of the Britannia, production of which is the responsibility of Short Bros. and Harland, Ltd. Basically 310s, they differ notably in that special provision has been made for heavy freight, including a large forward door and strengthened "floating" floor. Three 252s have been ordered by the Government for trooping operations by private airlines, and thirteen 253s for R.A.F. Transport Command.

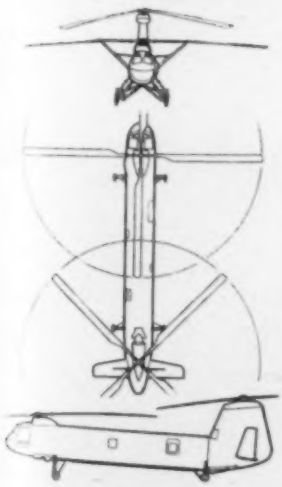
Britannia 100 Fifteen of the early version of the Britannia, production of which has ceased, have been in service with B.O.A.C. since February 1 this year.

Type 171 Sycamore As we go to press Bristol Aircraft, Ltd., announce that nearly 130 Sycamore single-rotor helicopters have been built and delivered and that nearly 50,000 flying hours have been logged by aircraft of the type in service with the Royal Air Force, the British Army, Royal Australian Navy, Royal Australian Air Force, Royal Belgian Air Force, German Armed Services (which placed an order for 50), British European Airways and Australian National Airways. A 4/5-seater, the Sycamore has an Alvis Leonides engine.

Type 173 Impressive demonstrations by this type of twin-rotor helicopter will be remembered from former S.B.A.C. Displays. The particular example illustrated on this page is the third prototype, which flew a few weeks after the former Display (November 9, 1956). It differs notably from its predecessors in being powered by two Alvis Leonides Major engines instead of single-row Leonides. The three Type 173s have been built under Ministry of Supply contract for intensive research into "military and civil applications of the multi-engine configuration."

Type 192 Shown in model form below, the Type 192 helicopter will be fitted with two Napier Gazelle Series 2 gas turbine engines, each of 1,300 s.h.p., and will be supplied in quantity to the Royal Air Force for troop and freight transport, ambulance duties, and search and rescue operations.

Operating as an ambulance, the 192 will carry 12 stretcher cases, three sitting wounded and a medical attendant. In the search-and-rescue rôle it will take ten or more rescued persons; and as a freighter it will lift a maximum distributed load of 6,000 lb.



THE DE HAVILLAND AIRCRAFT CO., LTD.

Hatfield Aerodrome, Herts. Telephone: Hatfield 2345

Comet 4 A fleet of 19 Comet 4s was ordered by B.O.A.C. in 1955 for operation on the Corporation's medium-stage Commonwealth network. This series represents the technical outcome of all the experience gained in 34,000 hr of earlier Comet airline service, and is due to enter service before the end of 1958. The engines are 10,500 lb thrust Rolls-Royce Avon RA.29s, flight experience on which is to be gained in Comet 2Es (see below).

The Corporation will employ its medium-range Comet 4s as partners for its long-range Boeing 707s.

Comet 4A The future of this version of the Comet, which was tailored especially to the needs of Capital Airlines, is now in doubt as a result of the deferment by that company of its order for ten. Probably it will not now be built; if Capital "re-activate" their Comet order they are most likely to specify Comet 4Bs. The 4A arose from Capital's need for higher speed and larger capacity. Cruising speed was increased to 520-545 m.p.h. (depending on temperature) by a reduction of span and by airframe strengthening, and seating capacity was increased to a maximum of 92 by a fuselage stretch of 40in.

Comet 4B This is the version of the Comet now being offered to the late-1959 market, although earlier delivery of Comet 4s can no doubt be made if required. The 4B represents probably the ultimate stretch of the Comet design, and it is aimed particularly at short/medium-range operations. To this end seating capacity has been increased to a maximum of 99 (84 first-class) by a further 38in fuselage stretch over the 4A; drag has been reduced by elimination of the wing-nacelle fuel tanks; first cost lowered from £1.21 million (for the 4A) to about £1 million (a reduction which has a marked effect on operating costs); and finally detailed attention has been given to quick terminal turn-round behaviour.

Interest in a small fleet—a figure of six has been mentioned—is at present being shown by B.E.A. to meet jet competition on their routes as from 1959.

Comet 2 The Series 2 is Transport Command's fastest trunk-route aircraft, of which a squadron of ten (No. 216, Lyneham, two T.2s and eight C.2s) has been intensively operated on scheduled and special services around the world for more than a year. The T.2s are all-passenger aircraft, and the C.2s have strengthened forward floors for heavy freight in addition to passengers.

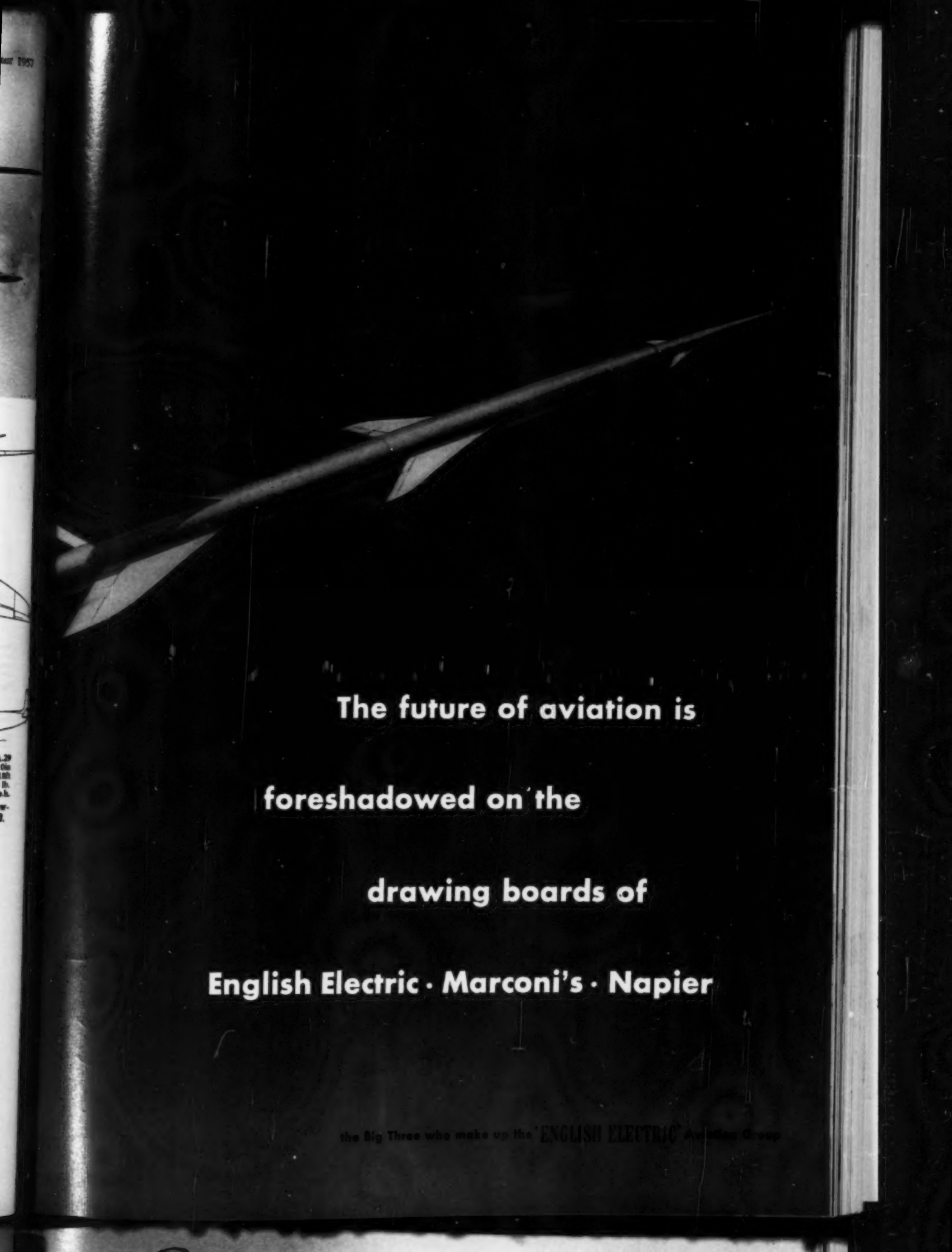
Comets have increased the R.A.F.'s transport mobility in a striking way, and have incidentally done much to re-establish the type into regular passenger-carrying service. The Comet 2s operated by Transport Command were already well advanced in construction for B.O.A.C. and other airlines; extensive modifications to the pressure cabin, wings and tail were made to permit unrestricted operation and a long life. Two other Comet 2s—structurally unmodified—are also to be used by the R.A.F. (not Transport Command) for special duties.

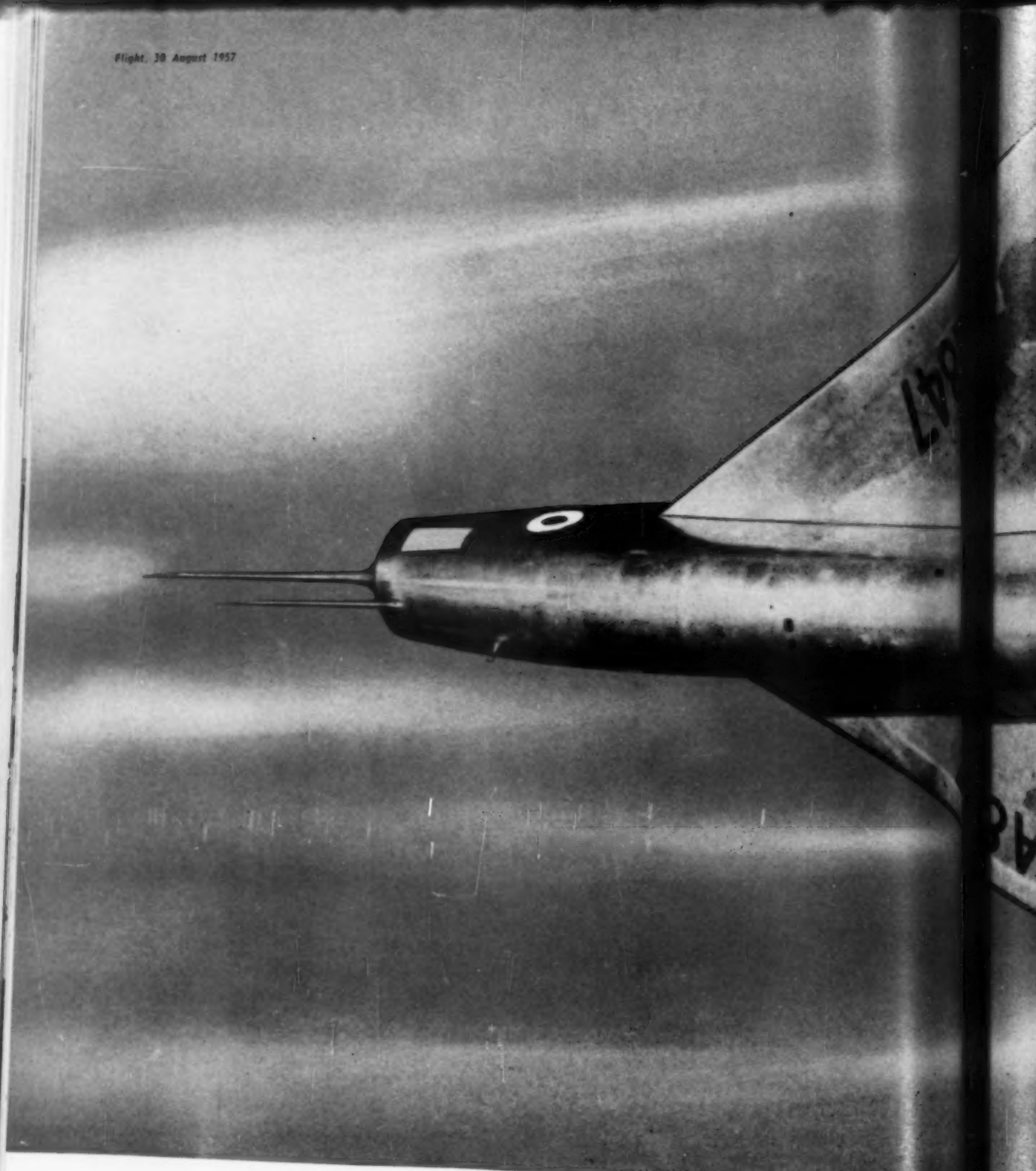
Comet 2E Two Comet 2s, fully modified for unrestricted passenger operation, have each been fitted with two Rolls-Royce Avon RA.29s—the engine of the Comet 4—in the outboard nacelles. The two aircraft are due to be used very shortly by B.O.A.C. for the purpose of amassing hours on this engine, and are to be operated on scheduled non-stop runs between London and Beirut by the newly formed Comet Unit. These operations will doubtless serve also as crew-training flights, and may be put to revenue-earning use by freighting. Fare-paying passengers will not be carried.

Comet 1A Two of the early Ghost-powered Comets remain in service; operated by the R.C.A.F., they have had the same structural modifications (mainly to the pressure-cabin) as were made to the R.A.F.'s Comet 2s.

Powerplant **Rolls-Royce Avon R.A.29**
Span 107ft 10in
Length 118ft
Gross weight ... 152,500 lb.
Typical cruising speed 520-545 m.p.h.

Photograph shows Comet 3. Drawing and data are for Comet 4B.


The future of aviation is
foreshadowed on the
drawing boards of
English Electric · Marconi's · Napier
the Big Three who make up the 'ENGLISH ELECTRIC' Aviation Group



The Incomparable P. 1B

THE ENGLISH ELECTRIC

This all-weather supersonic day and night fighter has been ordered in quantity for the Royal Air Force. With an all round performance better than any comparable aircraft in the world, and extensive armament including guided missiles, it represents an outstanding achievement in the field of military aviation.

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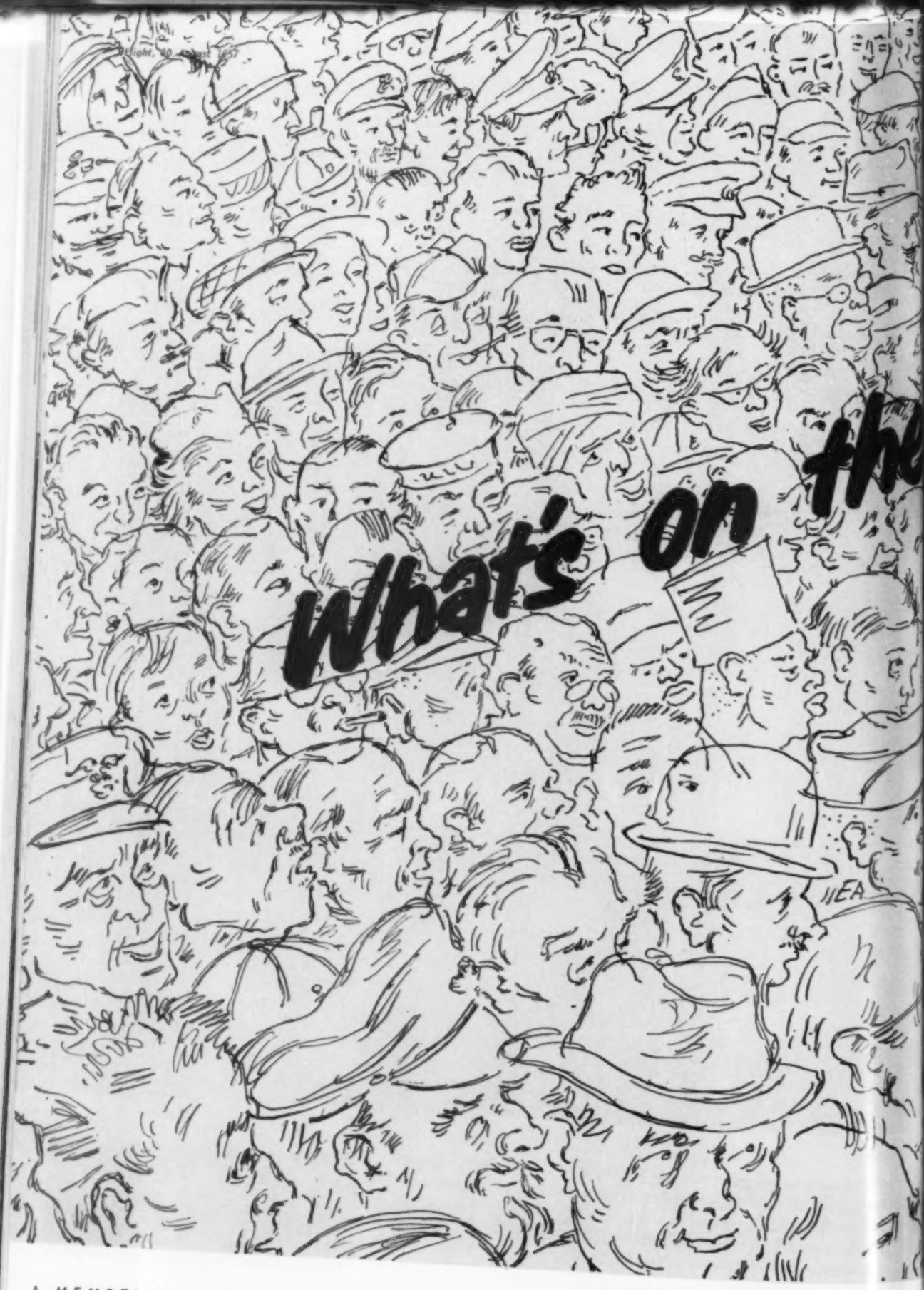
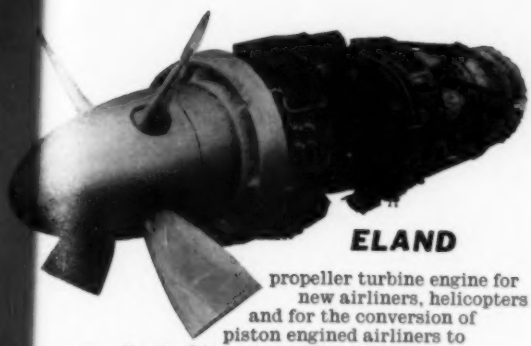
'ENGLISH ELECTRIC'
aircraft



A MEMBEI OF THE ENGLISH ELECTRIC AVIATION GROUP



ELAND

propeller turbine engine for new airliners, helicopters and for the conversion of piston engined airliners to propeller turbine power. Chosen for the HFB 209 project, the Fairey Rotodyne, the Westland Westminster and the Convair 340 and 440.

GAZELLE

free turbine engine designed primarily for helicopter propulsion; also adaptable for fixed wing applications. Chosen for the Westland Wessex and the Bristol 192.

SCORPION

An aircraft rocket engine which provides a source of extra power at high altitudes. Designed for sustained firing and long operational life.

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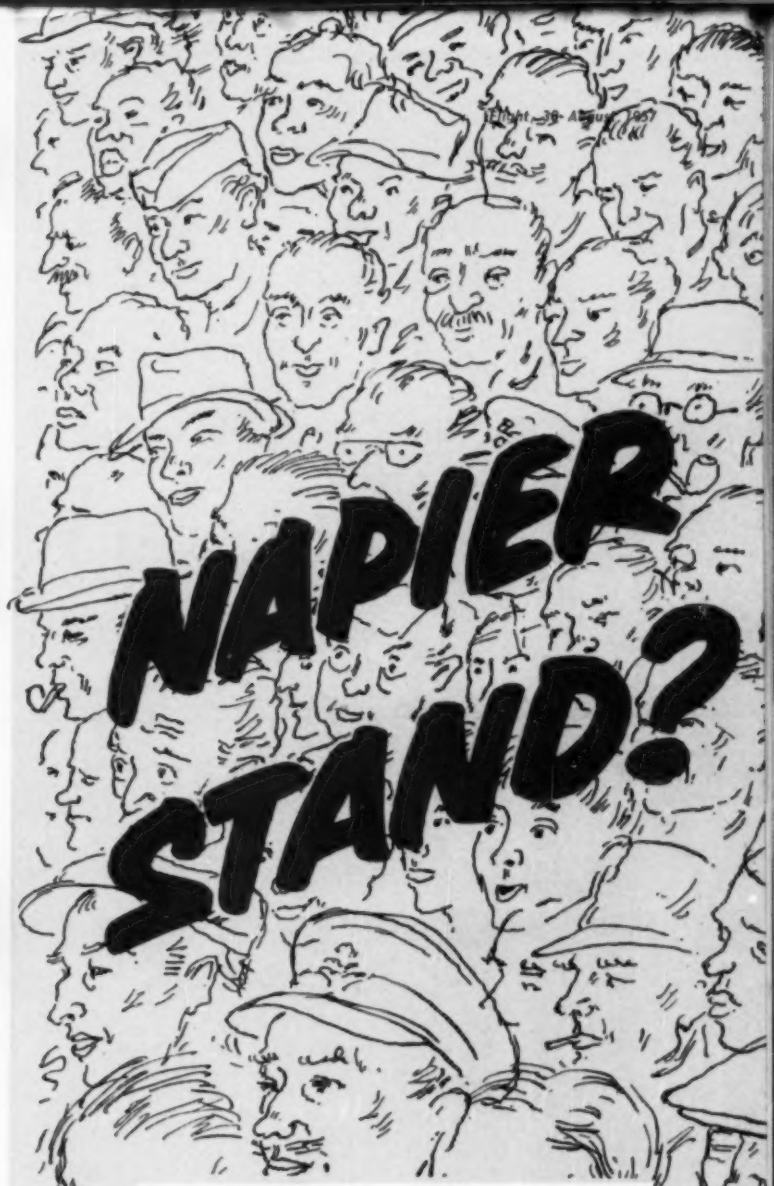
for helicopters restore performance lost through heat, humidity and height.

SPRAYMAT

the lightweight thermo-electric de-icing system now in use in the Fokker Friendship, the Bristol Britannia and many other military and civil aircraft.

NAPIER CASTINGS made by the investment method to the finest limits of accuracy.



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Between Experts

Napier activities extend over the whole aeronautical field. On the Napier stands you will find experts ready to discuss anything from de-icing to rocket boosters. They will be happy to give you fuller information about such exhibits as the Eland and Gazelle gas turbine engines, the Scorpion rocket aircraft engine, the Napier rocket booster system for helicopters or Napier precision investment castings. The technical advice and co-operation of the Napier organisation are available to interested enquirers during the Exhibition and at all times.

STAND B & No. 121

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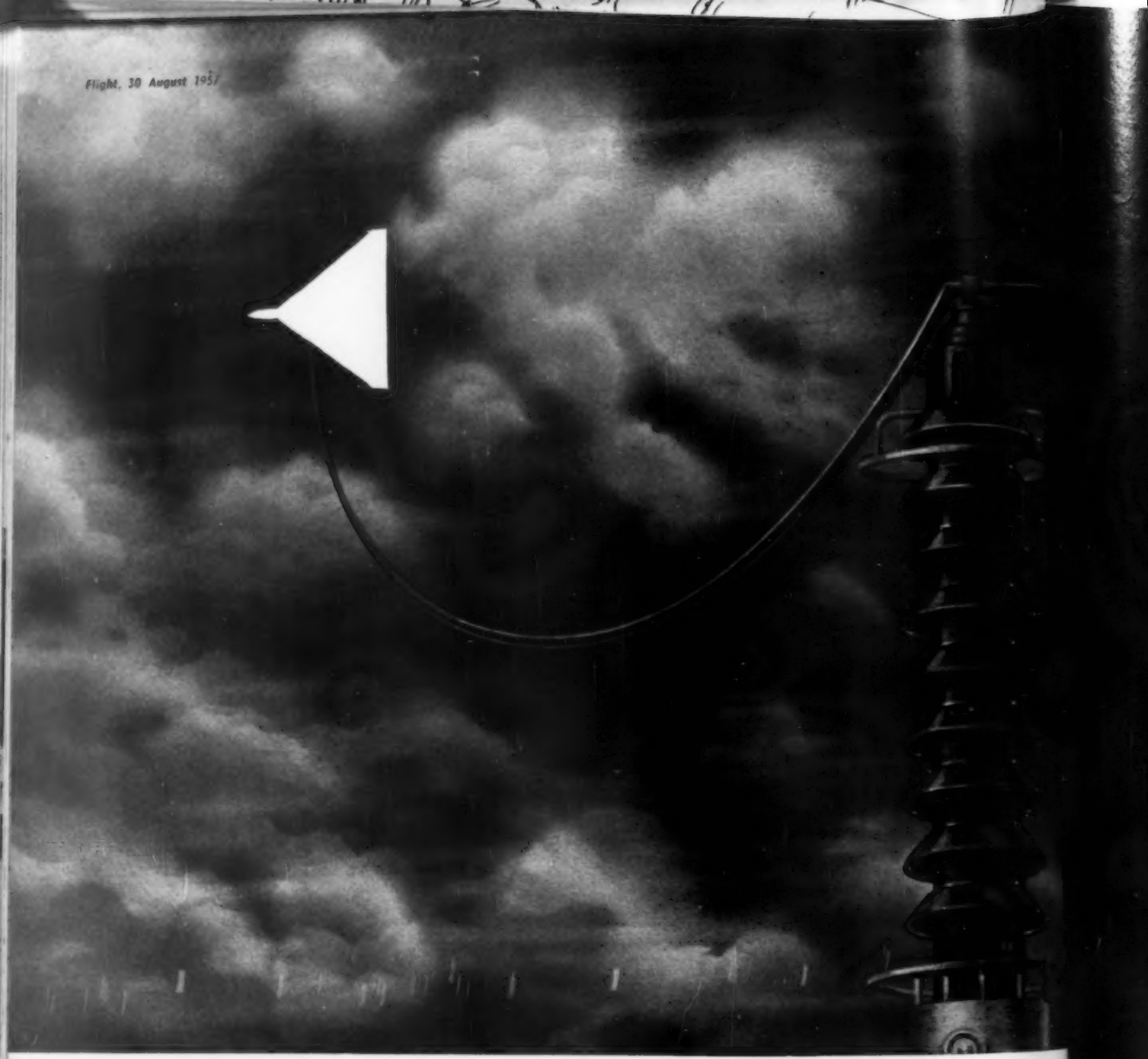


Airborne Power Station

The era is fast disappearing when the aeroplane's requirements for electrical power were little different from those of motor vehicles and the need was satisfied by D.C. generators and accumulators.

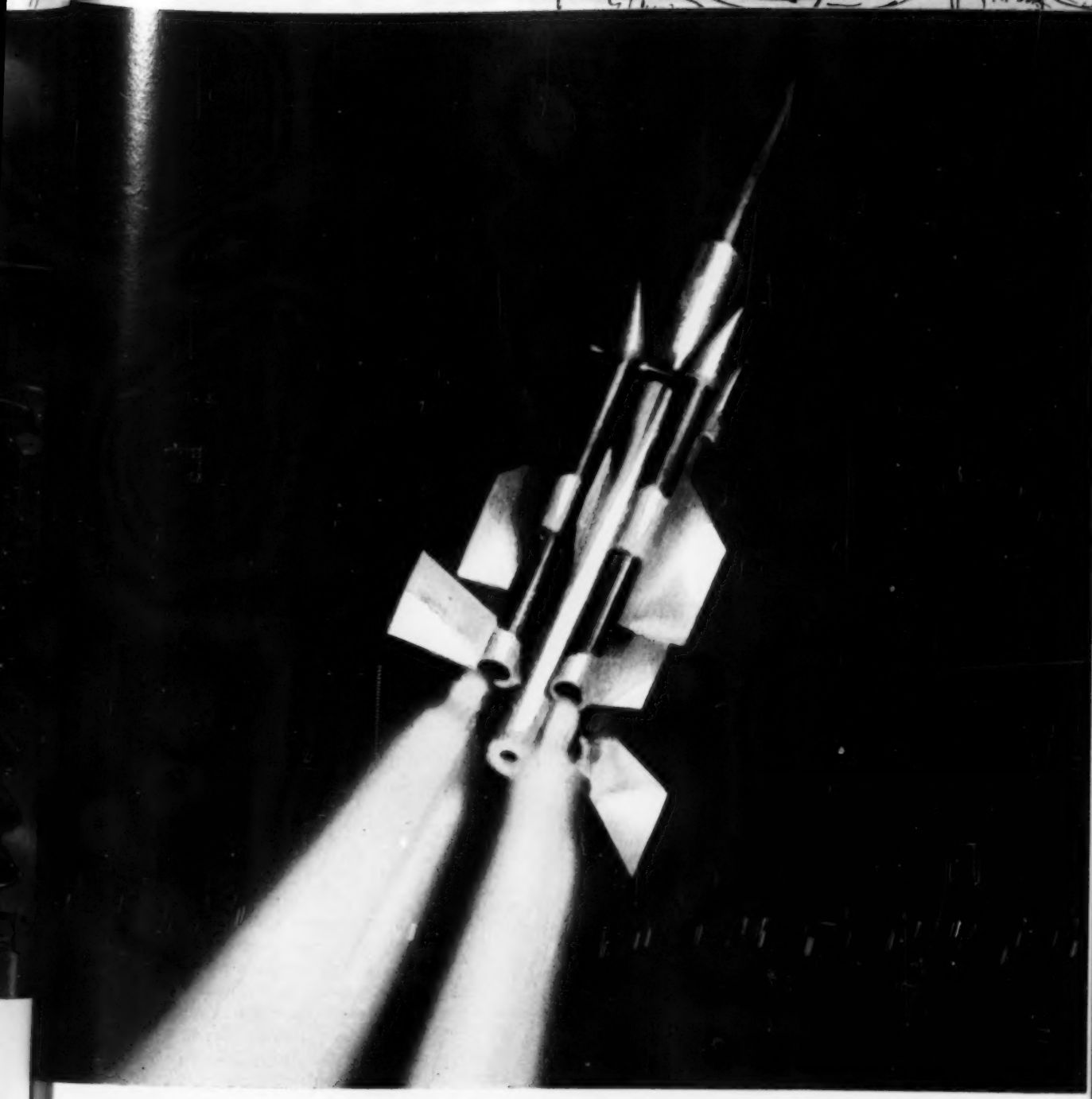
We agree that D.C. still has its use in the air for aircraft with limited power requirements but in the majority of large modern aircraft, where almost every moving part is operated or assisted by electrical power, the supply required is nearer the scale produced by a subsidiary power station. As with all generating stations, experience has proved that electrical power is provided more efficiently, economically and reliably in the form of constant frequency A.C. It is therefore fitting that ENGLISH ELECTRIC, who have designed and built so many of this country's—and the world's—major power stations, should be in the forefront of this revolution in technique. By undertaking the manufacture under licence of the well-proven Sundstrand Constant-speed Alternator Drive, and by developing simultaneously an expanded range of alternators, switch-gear, transformers and A.C. motors to aviation requirements, ENGLISH ELECTRIC have put themselves in a position to meet tomorrow's needs—however big—for the airborne power station.

'ENGLISH ELECTRIC'
aircraft equipment

THE ENGLISH ELECTRIC COMPANY LIMITED · AIRCRAFT EQUIPMENT DIVISION · PHOENIX WORKS · BRADFORD

AE28

ENGLISH ELECTRIC



'ENGLISH ELECTRIC' THUNDERBIRD

After hundreds of test firings at Aberporth and Woomera, the English Electric 'Thunderbird' ground-to-air guided missile has been given a production order. It will be used by the Services in both the static and mobile roles for defence against air attack.

'ENGLISH ELECTRIC' guided weapons

The ENGLISH ELECTRIC Co. Ltd · Guided Weapons Division · Luton · Stevenage · Woomera

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Over 50 Air Lines and 32 Air Forces

The intelligence on which the swift and complex operation of modern aircraft relies, whether for civil or military purposes, can depend upon Marconi radio equipment, navigational aids and radar. Marconi's experience in ground-to-air radio goes back to 1906 and they were investigating radar principles in 1929. Marconi's characteristic foresight and enterprise today are making possible still further progress in electronics for aviation, and, thereby, in aviation itself.

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MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX

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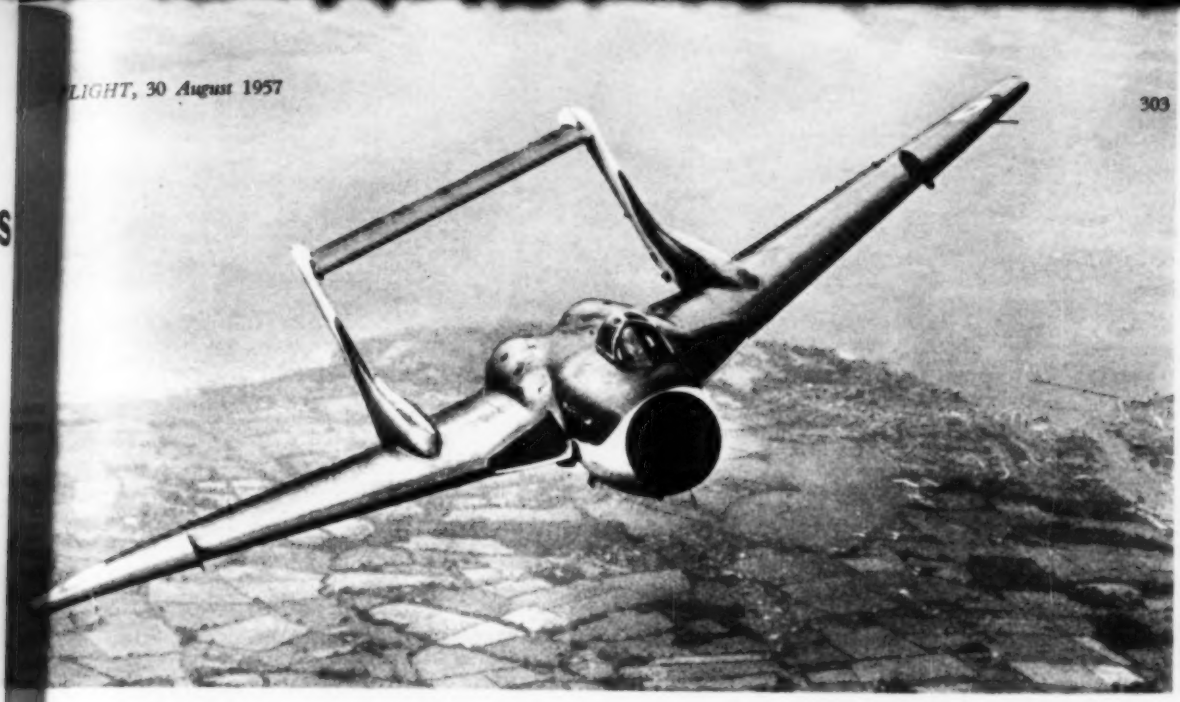
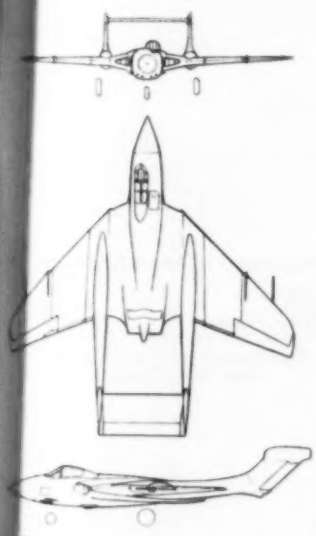




Powerplant	...	Two	Rolls-Royce Avon
Span	... ...	...	50ft
Length	... ...	53ft	6½in

Sea Vixen. Under the designation Sea Vixen FAW.20, the de Havilland two-seat night and all-weather fighter formerly known as the D.H.110 is now in full production for the Fleet Air Arm of the Royal Navy. The first series-built aeroplanes are coming through the shops at Christchurch, but responsibility for the main production effort will be vested in the company's main unit at Chester.

Principal characteristics of the Sea Vixen are high performance (the aircraft is supersonic in a very shallow dive); long endurance; heavy armament (a possible load is four de Havilland Firestreak guided missiles); and very full navigating and interception-radar equipment.

Handling qualities are of very high order, and a review by the Technical Editor earlier this year stated that the final control system of the Sea Vixen is probably unsurpassed in its all-round effectiveness over the entire speed range from supersonic to below 100 knots. The hydraulic circuits for the flying controls are energized by four pumps on an accessory box mounted between the two Rolls-Royce Avon turbojets. Both port and starboard drive-shafts incorporate a free-wheel so that the box is driven by whichever engine is turning the faster. The loss of one engine, therefore, has no effect on control power, and the proximity of the engines to the centre-line of the aircraft obviates asymmetric problems. In the unlikely eventuality of both Avons failing, hydraulic power can be maintained by extending an emergency ram-air turbine and pump unit. All control surfaces are actuated by duplicate tandem jacks, the two halves of each unit being connected into separate hydraulic circuits.

Catapult hooks are fitted beneath the roots of the main spar. This is a particularly good location, for it allows the towing bridle or strop to be widely spread, giving excellent longitudinal stability during acceleration. Installation of an arrester hook has also been accomplished very efficiently by virtue of the twin-boom configuration of the aircraft. The hook is attached to a strong frame at the rear of the powerplant bay and can be lowered hydraulically to a position in which its pull acts almost in line with the centre of gravity of the aircraft.

One of the most important of recent developments is the folding wing. The proportion of each surface which folds is considerable, the hinge axis coming just outboard of the tail boom. As a result the angular movement of the folding portion is no less than 100 degrees, in order to conform to the height imposed by carrier stowage limitations.

It was officially stated earlier this year that test-firings of missiles have already been made from the Sea Vixen.

Vampire Trainer. Such is the popularity of this excellent Goblin-powered advanced training aeroplane that it is now in service with over twenty air forces. Points of particular appeal are the ease of handling and the side-by-side seating. For instructional (or, if need be, tactical) purposes, it is possible to carry, in addition to the two (or four) 20 mm guns, several combinations of bombs and rocket projectiles.

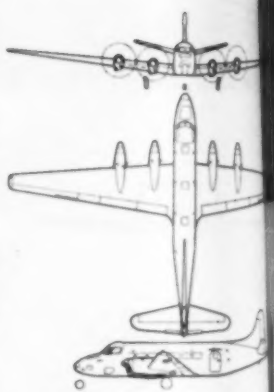
Vampire Trainer.

Sea Venom The Sea Venom is the naval counterpart of the R.A.F.'s Venom two-seat night fighter, which was itself a development of the Venom single-seat fighter/bomber. All three types continue in service and the Sea Venom will remain as the standard British naval aeroplane of its class until succeeded by the Sea Vixen. The built-in armament is four 20 mm guns, which are useful not only in the interception rôle, but when the Venom is employed on ground-attack operations, for which purpose it can carry an additional load of bombs or rocket projectiles. Pilot and observer—the latter operating the radar—are seated side by side in lightweight ejection seats. The latest operational mark is the FAW.22, which has a more powerful version of the de Havilland Ghost turbojet than had earlier models. The Sea Venom is serving also with the Royal Australian Navy.

Heron 2 Like its predecessor, the Dove, the Heron has proved adaptable to changing requirements. While airline capacity needs have increased, it has found a ready market in the executive-ownership field. Most of the production today is, in fact, for the business market, and the cachet "airliner in miniature" which has been applied to the Heron neatly sums up its appeal to the executive.

More than 100 Herons have now been built, and the Series 2 version in production today differs considerably from the early Heron 1. The original design conception was "utter simplicity"—fixed undercarriage, direct-drive unsupercharged Gipsy engines, no feathering propellers, no hydraulics, and so forth. Because demand dictated (particularly executive demand), the Heron 2 of today is a more refined aircraft, with retractable undercarriage and feathering propellers. Its greatest asset, uncommon in this size of aircraft, lies in its four engines, ensuring lively field performance and high safety standards.

Dove 5 and 6 The Dove was Britain's first post-war transport aeroplane, and to have maintained its attractions in a fast-changing market for 12 years is a remarkable achievement. The models in production today—Doves 5 and 6—are little changed from the early Dove, although the market at which the aircraft was originally aimed—the passenger transport market—has radically different requirements today. In the early post-war days the need was for a sophisticated development of small pre-war types like the Dragon Rapide; as traffic grew the airline industry demanded larger-capacity vehicles to carry its traffic economically. This led in 1950 to the Heron (described above); but the Dove readily found its way into other markets. Today production is almost entirely taken up by executive demand, and since this is a class of business which changes its requirements less rapidly than airline transport, the future of the Dove seems assured for some time ahead.

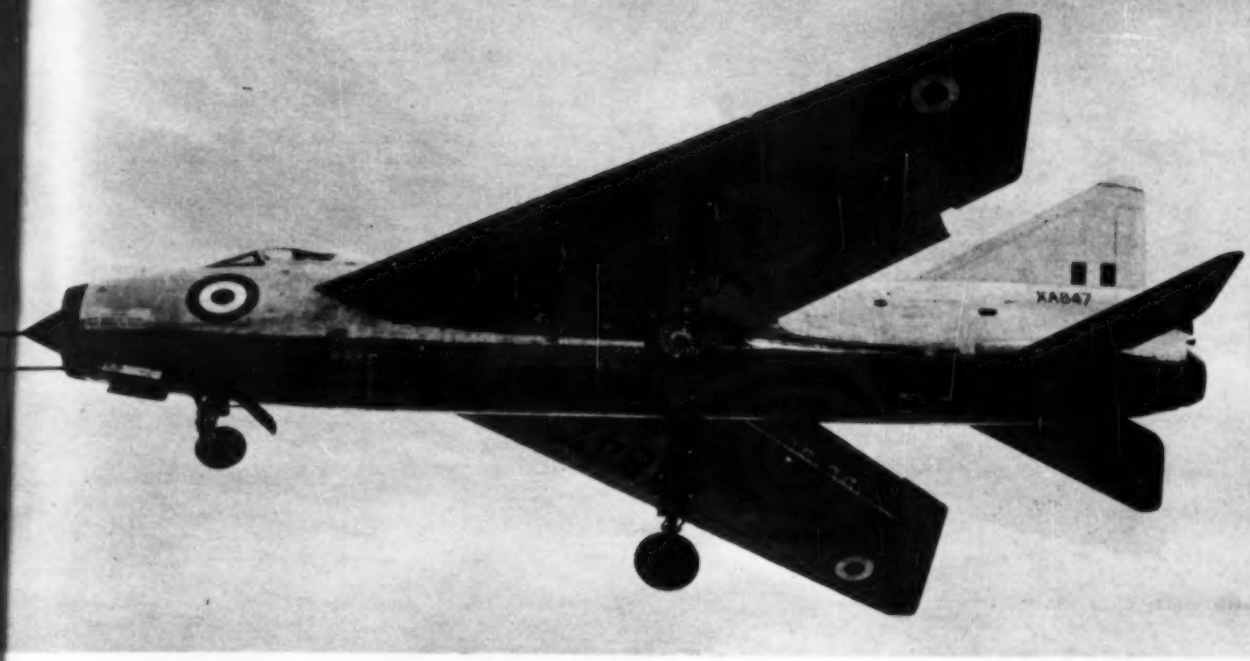


Powerplant	... Four D.H. Gipsy Mk. 2
Span	... 71ft 6in
Length	... 48ft 6in
Gross Weight	... 13,000lb
Typical cruising speed	185 m.p.h.

Drawing and photograph above show Heron Series 2.

Dove.

Sea Venom FAW.22



Powerplant		Two Rolls-Royce Avon
Span (P.1A)	... ...	34ft 10in
Length (P.1A)	... ...	49ft 8in

Photograph above and drawing below show P.1B.

THE ENGLISH ELECTRIC CO., LTD.

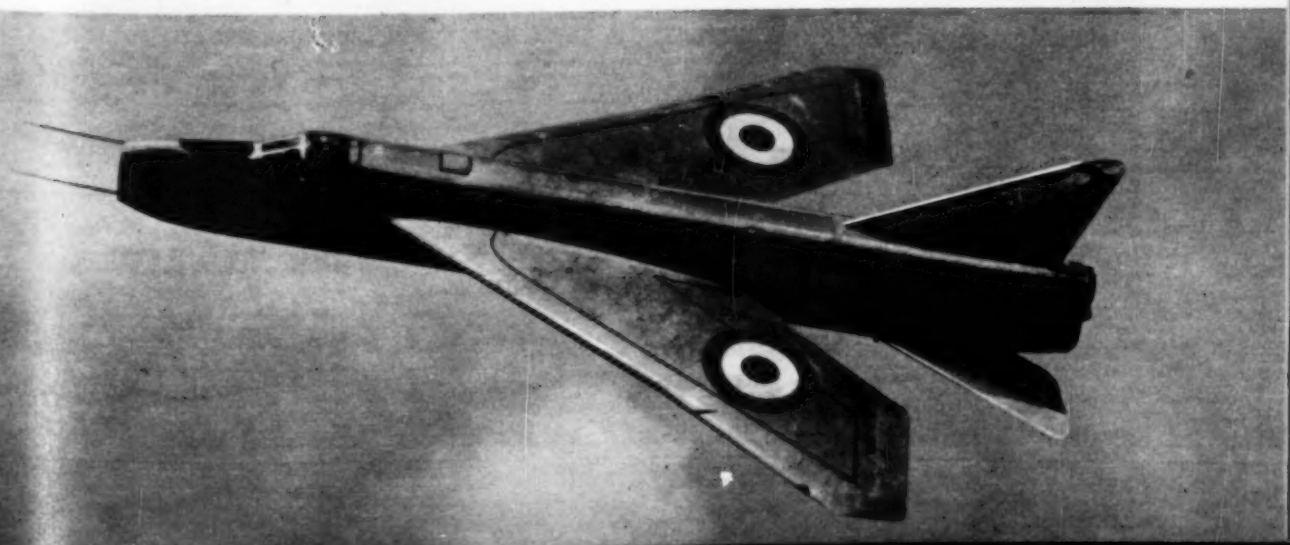
Queen's House, Kingsway, London, W.C.2. Telephone: Holborn 6966

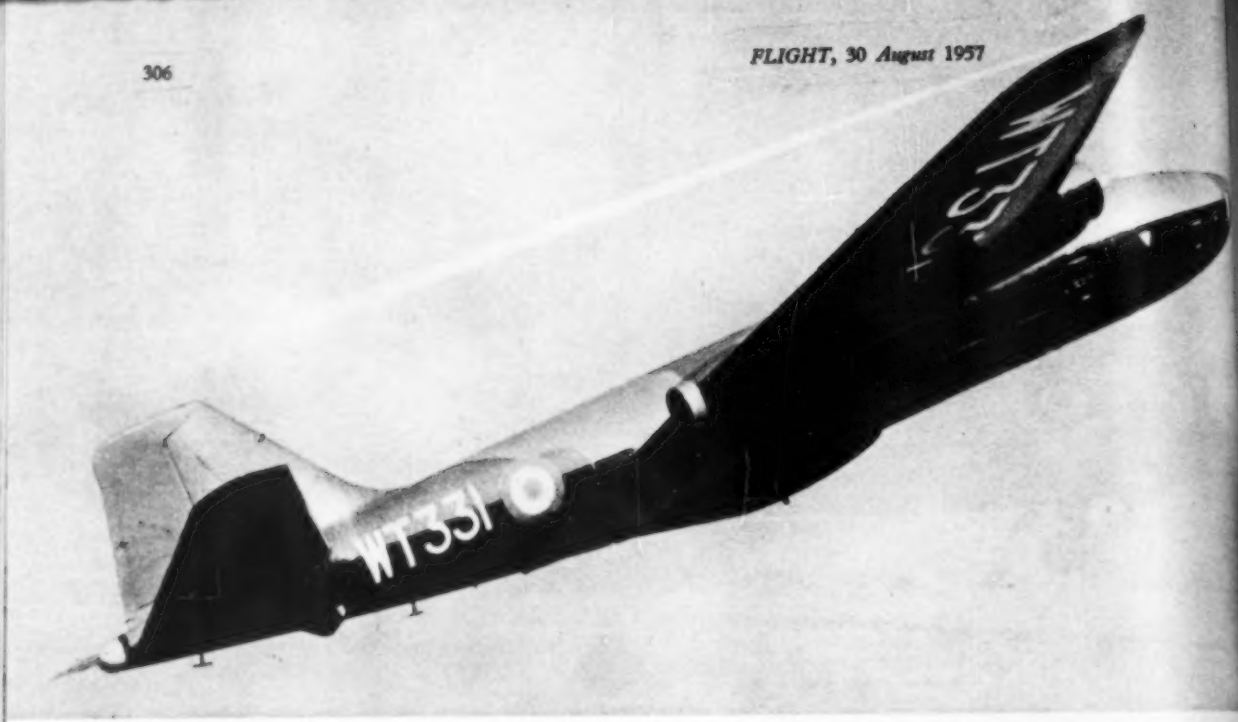
P.1B The P.1B (two Rolls-Royce Avon turbojets with reheat) is essentially the all-weather production version of the P.1 intercepter fighter for the R.A.F. It will be making its first public appearance in the S.B.A.C. Display this year. This aircraft is a development of the three P.1A prototypes and is an important advance in respect of performance and armament capacity. An English Electric announcement during July claimed that it has already flown at speeds in excess of the existing world's speed record. Two additional P.1B prototypes are to be built and will be followed by 20 pre-production aircraft; these will be utilized to develop the production standard. P.1 innovations since last year include an experimentally modified wing leading edge—near-conically cambered and cranked—to increase the tip chord and to reduce the thickness/chord ratio outboard of the vortex-control slots. A ventral fairing, which might serve as an auxiliary tank or rocket housing, is another development.

Although the de Havilland Firestreak is intended to be the principal weapon for production P.1Bs, the aircraft has also been planned to carry guns and, no doubt, spin-stabilized rockets. When the design was analyzed in detail in *Flight* of April 26 last, it was remarked: "It would be logical for special provision to have been made for permitting the type of armament carried to be changed rapidly and easily during field service. All the equipment associated with the various types of armament is likely to be available in package form within the time scale of the aircraft, thus fulfilling a major requirement of the weapon-system doctrine."

It is officially expected that the P.1 will be the last manned fighter to be supplied to the R.A.F. An important development potential may therefore be inferred.

P.1A.



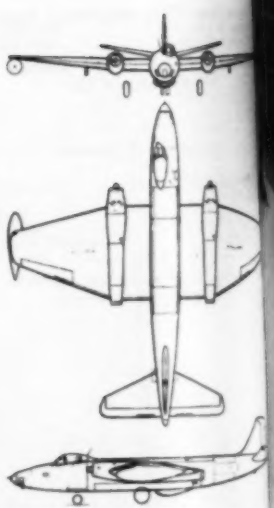


ENGLISH ELECTRIC CO, LTD.

Queen's House, Kingsway, London, W.C.2. Telephone: Holborn 6966

Canberra B(I).8 Truly a multi-purpose aeroplane, this eighth mark of Canberra is being supplied to the R.A.F., India, Peru and Venezuela. Earlier marks—specialist variants for bombing, reconnaissance and training—have been adopted by Great Britain, Ecuador, Venezuela and New Zealand; and versions of the basic design—American built—are widely employed by the United States Air Force. The B(I).8 can be used for bombing, low attack or reconnaissance. A recent development is an adoption of the L.A.B.S. bombing technique.

Canberra P.R.9 This ultra high-altitude photographic reconnaissance Canberra, with advanced Rolls-Royce Avons, increased span and deepened centre-section chord, is in production for the R.A.F. at the works of Short Brothers and Harland, Ltd.



Powerplant	Two Rolls-Royce Avon
Span	64ft
Length	65ft 6in

Drawing and photograph above show Canberra B(I).8.

Canberra P.R.9.

ever since the industry gained its wings . . .

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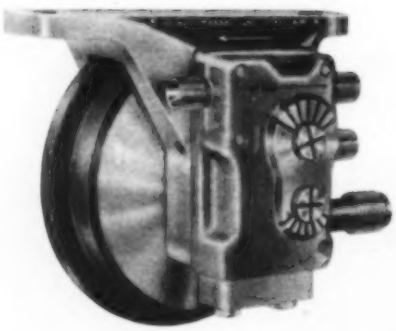
WITH AN EVER-INCREASING RANGE OF EQUIPMENT

NATURE designs her creatures in a way that can never be equalled by the machine. Those that fly take-off and land with smoothness and precision. That machines have even approached this ease and facility is due to many skills: those of designer, constructor, pilot but also, in many of the world's aircraft, to Dunlop tyres, wheels and brakes.



EVEN the natural instincts of the wild-fowl can be baffled by the unexpected. Just as in landing the most experienced among pilots can seldom anticipate the moment when a skid may occur. With 'Maxaret' Anti-Skid Units the pilot need have no such anxiety. As soon as the wheels approach the point of skidding these units automatically release the brake pressure until forward speed is regained. In the event of a "bounce" landing, brakes are "held-off" until contact with the runway is again established.

LEAVING the coasts of Florida, the Canada goose flies high to its Arctic nesting grounds, impervious to changing temperatures. It is equipped not only with feathers, which provide admirable insulation, but a natural heating system. Aircraft are not so fortunate in this respect. But those responsible for design and production can always call upon Dunlop for experienced assistance with de-icing problems.

VER since the early days of flying, Dunlop has erved aviation. The illustrations on these wo pages are appearing throughout the year n announcements covering part of the very extensive range of equipment with which Dunlop now serve the industry.

MAN has trained birds of prey to become guided missiles, magnificently co-ordinated to seek and destroy their quarry. In the development of military and research missiles and rockets, only the closest co-operation between chemists, physicists, engineers and designers can approach the instinctive accuracy of eyes, brain, wings and talons of the predatory bird. Dunlop is contributing to this branch of aeronautical activity by providing equipment for the propulsion, guidance and armament of the guided missiles now in production.

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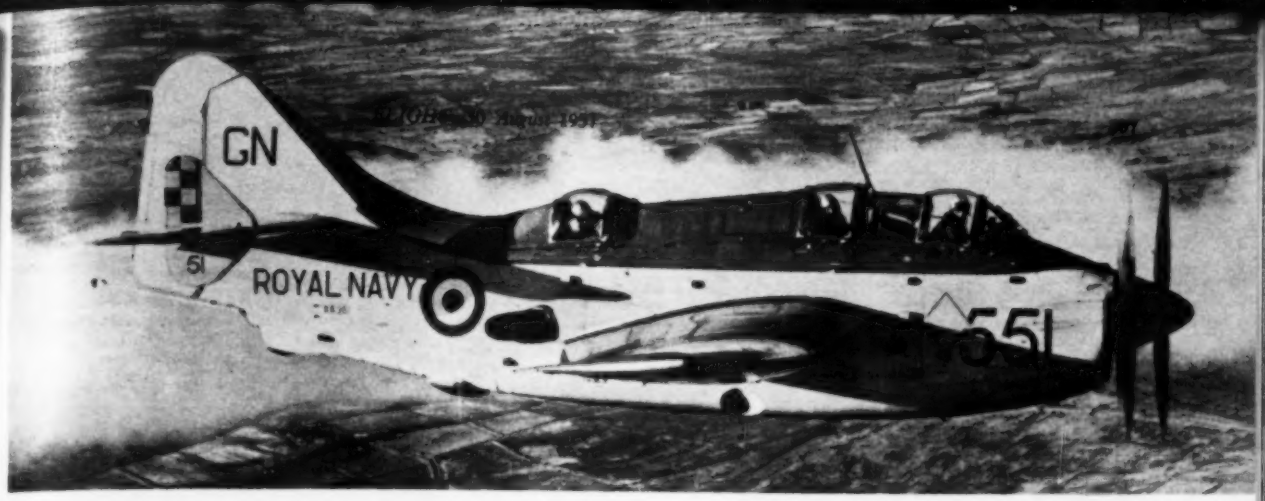
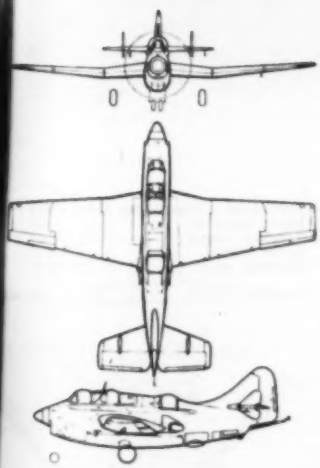
● DUNLOP RUBBER CO. LTD. (AVIATION DIVISION) FOLESHILL, COVENTRY





THE FAIREY AVIATION CO, LTD.

Hayes, Middlesex. Telephone: Hayes 3800

Gannet (Anti-submarine) The current production version of the anti-submarine Gannet is the A.S.4, which differs from the A.S.1 in equipment and powerplant rating. Anti-submarine Gannets have been adopted not only by the Royal Navy and the Royal Australian Navy, but are to be supplied also to the West German Government. Of the Gannet's several unorthodox features, the Armstrong Siddeley Double Mamba powerplant is perhaps the most remarkable. Since the specific fuel consumption of a turboprop engine actually increases as the engine is throttled, the Fairey Company themselves suggested that twin turbines, coupled to drive counter-rotating propellers, would show notable economies, for one half of the engine could be shut down while the other was run at an efficient point on the consumption curve for cruise.

Gannet (Trainer) The new Gannet T.5 bears the same relationship to the earlier T.2 as does the A.S.4 to the A.S.1. Both marks provide advanced training in weapon and engine handling.

Gannet (Early Warning) The Gannet A.E.W.3 is a special early-warning aircraft now in production for the F.A.A. and differs very considerably from other Gannets.

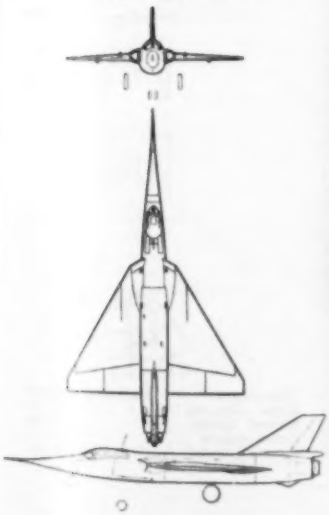
F.D.2 The official world's speed record of 1,132 m.p.h., established on March 10, 1956, by Mr. Peter Twiss in a Fairey F.D.2 delta-wing research aircraft (Rolls-Royce Avon turbojet with reheat) continues to stand firm at this date. A matter for reflection and satisfaction—especially so as it is known that the F.D.2 is capable of yet higher sustained speeds. Two of these superb aeroplanes have been built.

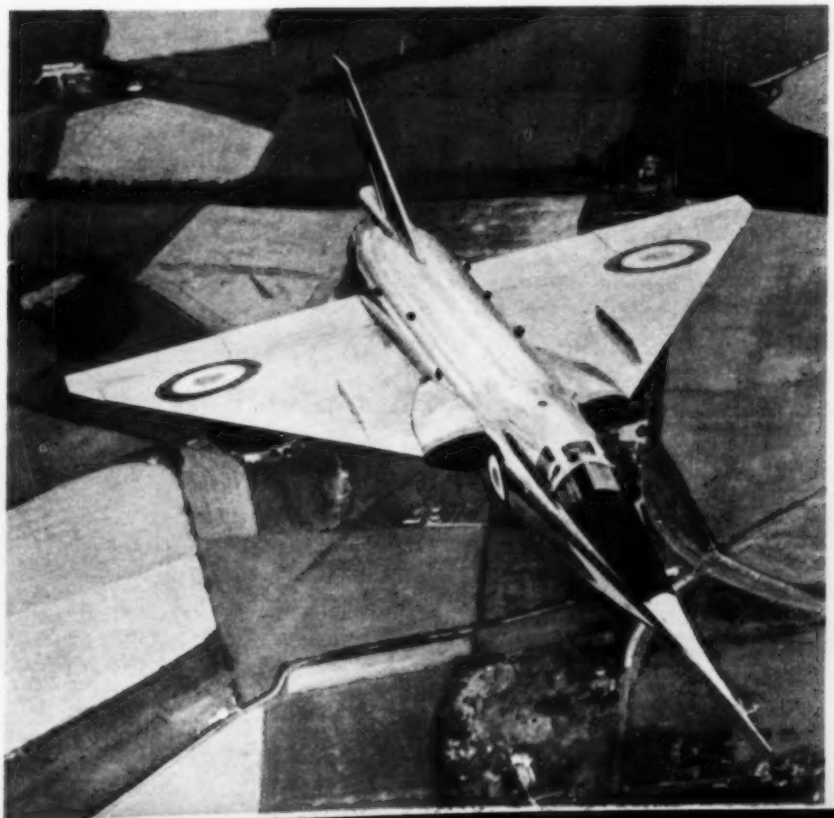
Powerplant	Armstrong Siddeley Double Mamba
Span	54ft 4in
Length	43ft

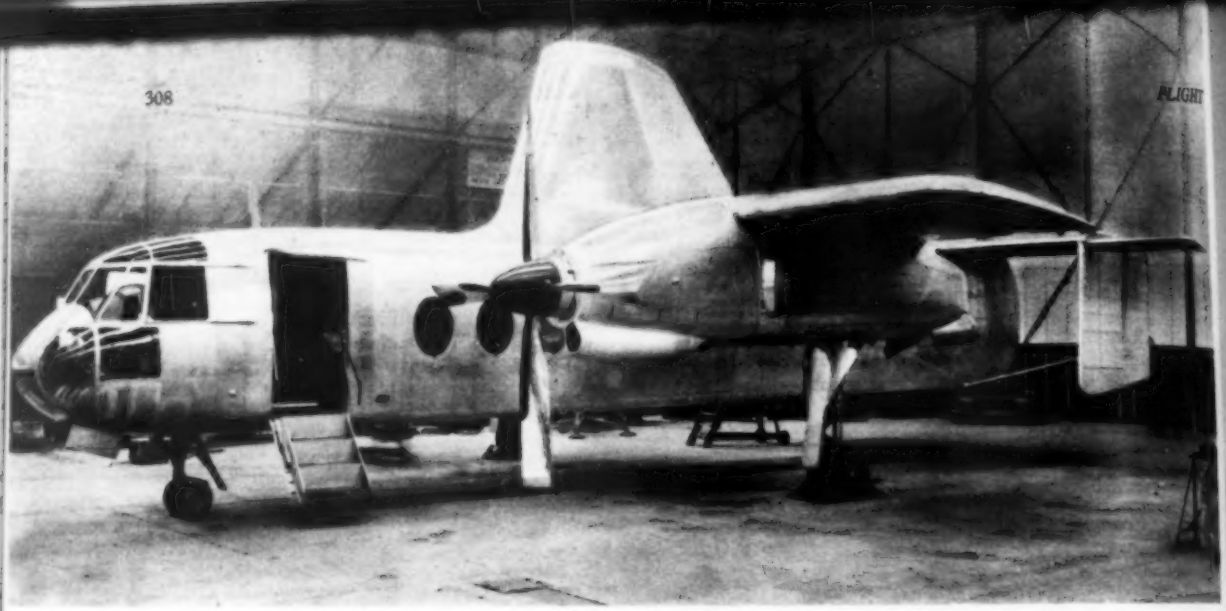
Drawing and photograph above show Gannet A.S.4. Side view below shows A.E.W.3.

Powerplant ...	Rolls-Royce Avon
Span	27ft
Length	52ft

Drawing below and photograph at right show F.D.2.





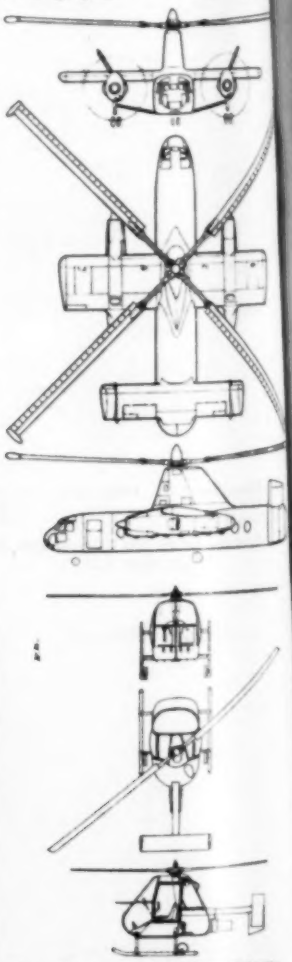


Rotodyne The Rotodyne is a unique and extremely interesting aircraft, for which its makers entertain the highest hopes. The first prototype is due to fly before the end of the year; this machine—a 40-seater—is illustrated above in unfinished state and was the subject of a very detailed, illustrated description in our issue of August 9 last.

The Rotodyne has a single lifting rotor, a fixed wing and two propellers driven by Napier Eland turboprops. Each Eland feeds compressed fresh air to the rotor. At take-off, most of the power is absorbed in supplying the rotor with this air, which feeds kerosine-burning pressure jets at the tips of the blades. Forward movement is then achieved by tilting the rotor axis until, at a speed of 100 kt, power is gradually transferred to the propellers. The aircraft is then cruising solely on the thrust of the propellers, with the rotor autorotating. For landing, the process is reversed.

Ultra-Light The basic powerplant of this little helicopter is a Blackburn-Turboméca Palouste turbo-generator. Fairey pressure-jet units at the blade tips burn fuel mixed with compressed air, fed out through the hollow blades from the Palouste—a system which confers a rate of climb claimed to be higher than that of any other helicopter in the world. Important civil and military applications are in view.

Powerplant	Two Napier Eland NEL
Rotor diameter	90ft
Fuselage length	58ft 10in
Gross weight	39,000 lb
Cruising speed	170 m.p.h.



Powerplant	Blackburn Palouste
Rotor diameter	28ft 3in
Overall length	14ft 8in
Gross weight	1,798 lb
Cruising speed	95 m.p.h.

FOLLAND AIRCRAFT, LTD.

Sydney Lodge, Hamble, Hants. Telephone: Hamble 3191

Powerplant	...	Bristol Orpheus
Span	...	22ft 2in
Length	...	29ft 9in
Gross weight	...	6,200 lb
Maximum level Mach number		0.98

Drawing and photograph above show Gnat Mk 1

Gnat Mk 1 It is pleasing to record that during the past 12 months the Gnat light fighter has been adopted by the Governments of India and Finland. Six specimens have also been delivered to the Ministry of Supply.

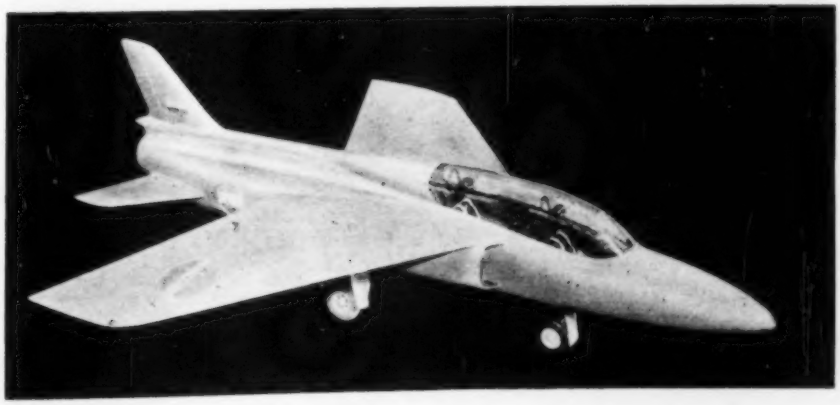
The design philosophy and essential characteristics of the Gnat are already familiar. A recent development has been the introduction of a hydraulically operated slab tail in place of the variable-incidence tailplane and elevator formerly used. This, the makers state, has ensured that excellent manœuvrability continues unbroken into the supersonic region.

The Gnat's built-in armament is two 30 mm Aden guns, each with 150 rounds, which is sufficient for about six seconds' firing. Possible external loads are two bombs and two drop tanks; two drop tanks and rocket projectiles; 12 rocket projectiles and no drop tanks; and a drop tank and a camera pod, the latter carrying three F.95 cameras under the starboard wing. Cabin pressurization starts at 15,000ft and maximum differential is 3½ lb/sq in at 40,000ft and above. Standard equipment is one multi-channel V.H.F. transmitter/receiver, with single-channel stand-by and tele-briefing, radar ranging, I.F.F. and a radio compass or other navigation aid.

At full load the intercepter Gnat requires 760 yd to clear a 50ft screen under tropical sea-level conditions, and under the same conditions the tactical version requires 1,375 yd.

A thinner—6 per cent—wing has already been designed, and this, coupled with up-rated versions of the Orpheus, will give "full supersonic capabilities". To these may be added A.I. equipment and guided weapons (as an alternative to the two Aden guns). Mention has been made of Gnat "supersonic Mk 2 and Mk 4 developments".

Gnat Trainer This transonic tandem-seat development of the Gnat 1 has a one-piece clear-view canopy and seats of the Folland-Saab lightweight pattern. All essential controls and instruments are duplicated, and the space normally occupied by the guns is used for additional fuel to give a high-altitude endurance of an hour, or allow for ten consecutive practice landings. The nose has been somewhat lengthened.



Gnat Trainer (model)

GLOSTER AIRCRAFT CO., LTD. *Gloucester, Glos. Telephone: Gloucester 67011*

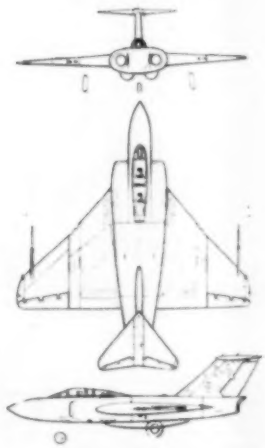
Javelin (Fighter) The newest mark of Javelin two-seater all-weather fighter in production for the Royal Air Force is the FAW.7. A machine of this mark will be flown in the S.B.A.C. Display this year with four de Havilland Firestreak guided missiles on its underwing pylons. Additionally the FAW.7 carries the four 30 mm Aden guns which formed the sole armament of its predecessors. A great amount of search radar and electronic navigational equipment is carried, but notwithstanding its bulk and weight the Javelin has an excellent performance—strictly comparable with that of the Hunter single-seater—and attains a very high standard of manœuvrability. It is popular with its crews and it has been officially stated to be capable of dealing with the bombers of any potential enemy. Armstrong Siddeley Sapphire turbojets are standardized.

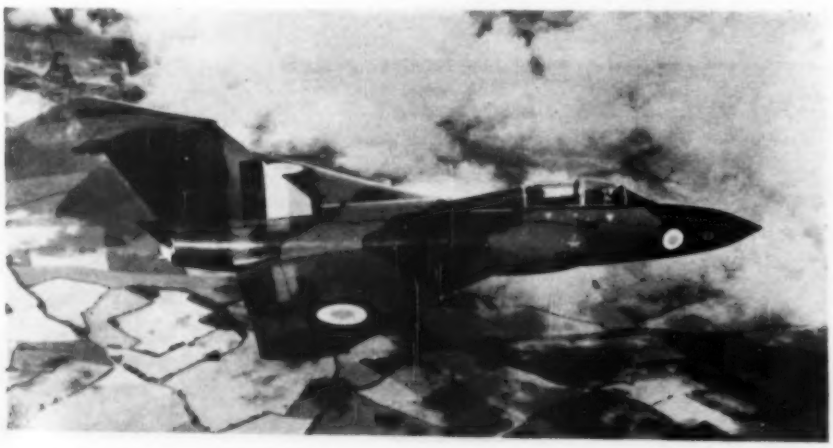
The FAW.7 to be demonstrated at Farnborough will be a production machine with the lengthened fuselage as incorporated in the development aircraft shown in the photograph above. This extension has been added principally for aerodynamic reasons, but it might also accommodate a simplified form of reheat. Note also that the aircraft depicted is carrying two external fuel tanks.

Javelin (Trainer) Introduced at last year's S.B.A.C. Display was the Javelin T.3, the prototype of which was developed by Air Service Training, Ltd., from a fighter airframe of early mark. This version will again be represented this year, and the type is scheduled to enter R.A.F. service to provide specialized training for the pilots of the Javelin fighter squadrons now being re-equipped. In the T.3 both cockpit canopies are considerably higher, and the ejector seat for the instructor (at the rear) is raised several inches above that of the pupil. Moreover, the rear seat is positioned further forward than that of the radar observer in the Javelin fighter, and the whole nose has therefore been lengthened. The radome is now much shorter and contains only a radar-ranging unit. A fitting of particular interest is the periscope for the instructor, which has sighting lenses mounted in the leading edge of streamlined projections attached some way below the cockpit coaming.

Powerplant
Two Armstrong Siddeley Sapphire
Span 52ft
Length 56ft 4in

Photograph above shows FAW.7 development aircraft. Drawing below is of FAW.4.

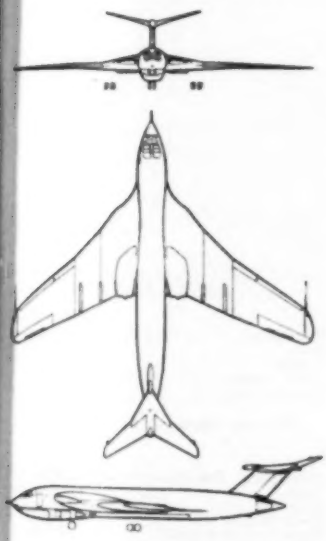




Left, Javelin T.3.

Powerplant
Four Armstrong Siddeley Sapphire
Span 110ft
Length 114ft 11in

Photograph above and drawing below show Victor B.1.



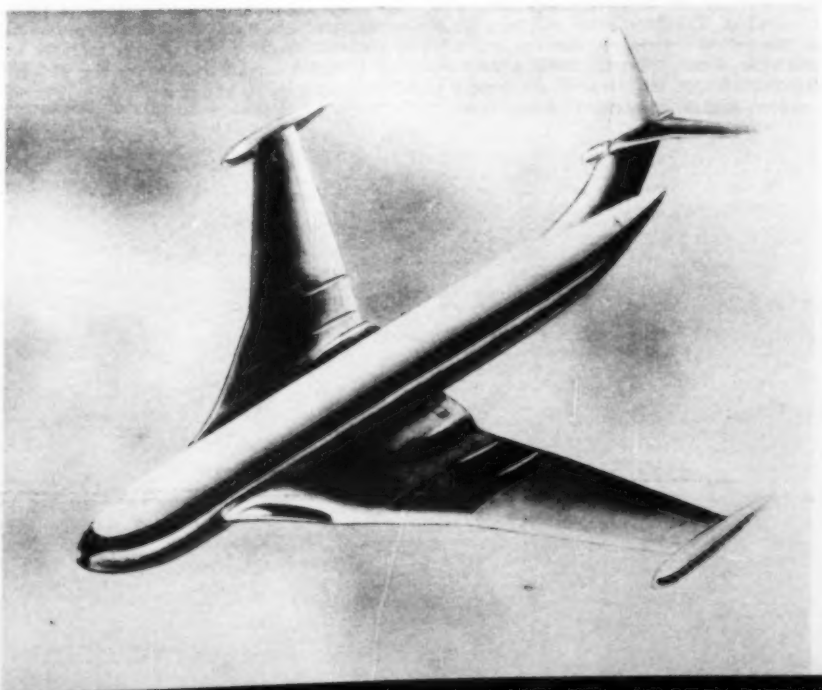
HANDLEY PAGE, LTD.

Clarement Road, Cricklewood, London, N.W.2. Telephone: Gladstone 8000

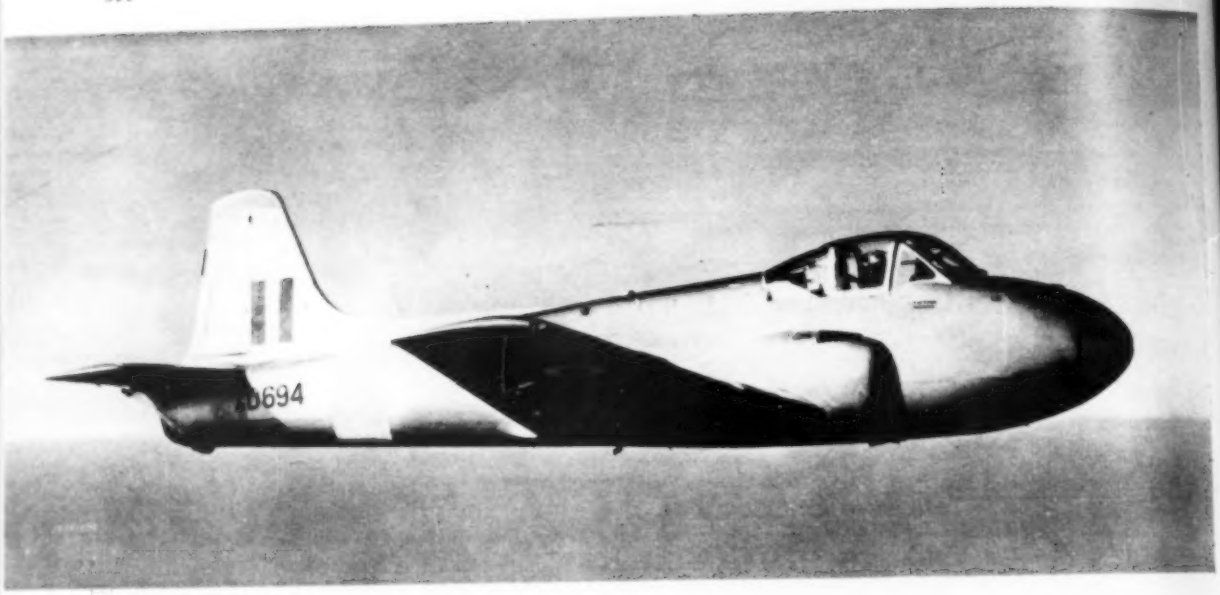
Victor B.1 During the coming months Victor B.1 medium bombers, powered with four Armstrong Siddeley Sapphire turbojets, will be entering Royal Air Force service with No. 3 Group, Bomber Command. The essential characteristics of this fine machine—notably its crescent wing—will be remembered from earlier years. Highlight of Victor news during the past twelve months has been the revelation that in the course of a test flight one of these bombers exceeded Mach 1 in a shallow dive. *Flight's* report of this event read: "At the same time several members of the Handley Page company near Radlett heard a loud sonic boom; it was heard, also, in Southern Hertfordshire. The Machmeter was subsequently calibrated, and it is claimed that its indication was accurate and that the Victor exceeded the speed of sound at about 40,000ft by about 15 m.p.h. There was apparently no other instrumentation aboard which would prove this claim conclusively. The boom provides strong circumstantial evidence."

Victor B.2 It has been officially announced that the Victor B.2s on order for the Royal Air Force are to be powered with four Rolls-Royce Conway RCo.11 by-pass turbojets, each delivering a thrust of the order of 17,250 lb. In conjunction with airframe improvements, the Conways will confer a notable increase in performance.

Civil Victor Handley Page have long been aware of the commercial potentialities of their strategic bomber. Indeed, at the 1952 S.B.A.C. Display the company presented a transport project based on the design of their then forthcoming Victor. Now, with three years' practical test experience of that aeroplane, they have been able to offer a much-improved civilian



Right, Civil Victor (artist's impression).



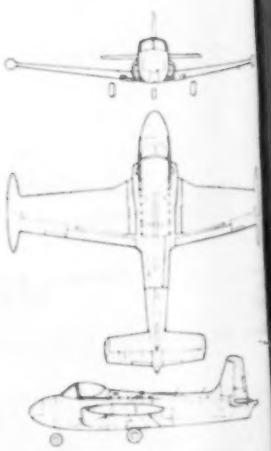
HUNTING PERCIVAL AIRCRAFT, LTD.

Luton Airport, Beds. Telephone: Luton 6060

Jet Provost It was announced in February this year that the Royal Air Force had decided to adopt "all-through" training on jet aircraft, and to this end quantity production of the Jet Provost basic trainer has been ordered. The sub-type concerned is the T.3, which will differ from the development aircraft illustrated above in having ejector seats and revised canopy. By February last 50 R.A.F. pupils had been introduced to the Jet Provost. Of these, 35 had no previous flying experience and 15 had flown light piston-engined types. Forty-nine went solo and one failed to make the solo stage and was transferred. Of the 35 without previous flying experience, the lowest recorded time to solo was 7 hr 5 min. The average for all 35 was 10 hr 10 min. Of the 14 with previous experience the lowest recorded hours to solo were 4 hr 55 min and the average for the 14 pupils 7 hr 25 min.

Standard Jet Provost fitments include air brakes, oxygen equipment and cabin-conditioning, and lightweight ejector seats are optional. The speed range extends at full load from 65 kt to 286 kt in level flight, and the structural design diving speed is 380 kt (M = 0.7). The aerodynamic Mach number limitation is, in fact, considerably in excess of this figure.

The following are extracts from the report by a member of *Flight*'s staff on handling the Jet Provost: "Now that I have sampled the Jet Provost I can well understand how the R.A.F. flying training authorities arrived at their very high opinion of the machine as a basic trainer. I have flown a number of light jet aircraft from the Vampire Trainer down to the Sipa 200 Minijet; but in none of them did I find exactly the Jet Provost combination of real jet-aircraft handling characteristics with true simplicity and moderate performance. The main purpose of a turbojet basic trainer is, after all, to teach a pupil from the outset the essentials of jet aircraft handling while not exposing him from the very first to the blistering performance he will later meet in his operational type."



Powerplant	Armstrong	Siddeley Viper
Span		35ft 2in
Length		31ft 11in
Gross weight		7,050 lb
Max. speed		330 m.p.h.

Drawing and photograph above show Jet Provost.

Pembroke Designed to perform a variety of rôles in support of modern armed forces, the Pembroke entered R.A.F. service during 1952. Since that date it has been adopted by the air forces of Belgium, Denmark, Finland, Rhodesia and Sweden, and machines of the same type are to be supplied to the newly reconstituted West German Armed Forces. Versatility is the essence of the Pembroke's appeal. Basically a communications aircraft (equipped

Pembroke (for Belgium

Jet Provost

Powered by one Armstrong Siddeley Viper Turbo-Jet.

The only turbo-jet aircraft in the world to have been accepted for the ab initio training of military pilots. Now in production for the Royal Air Force.

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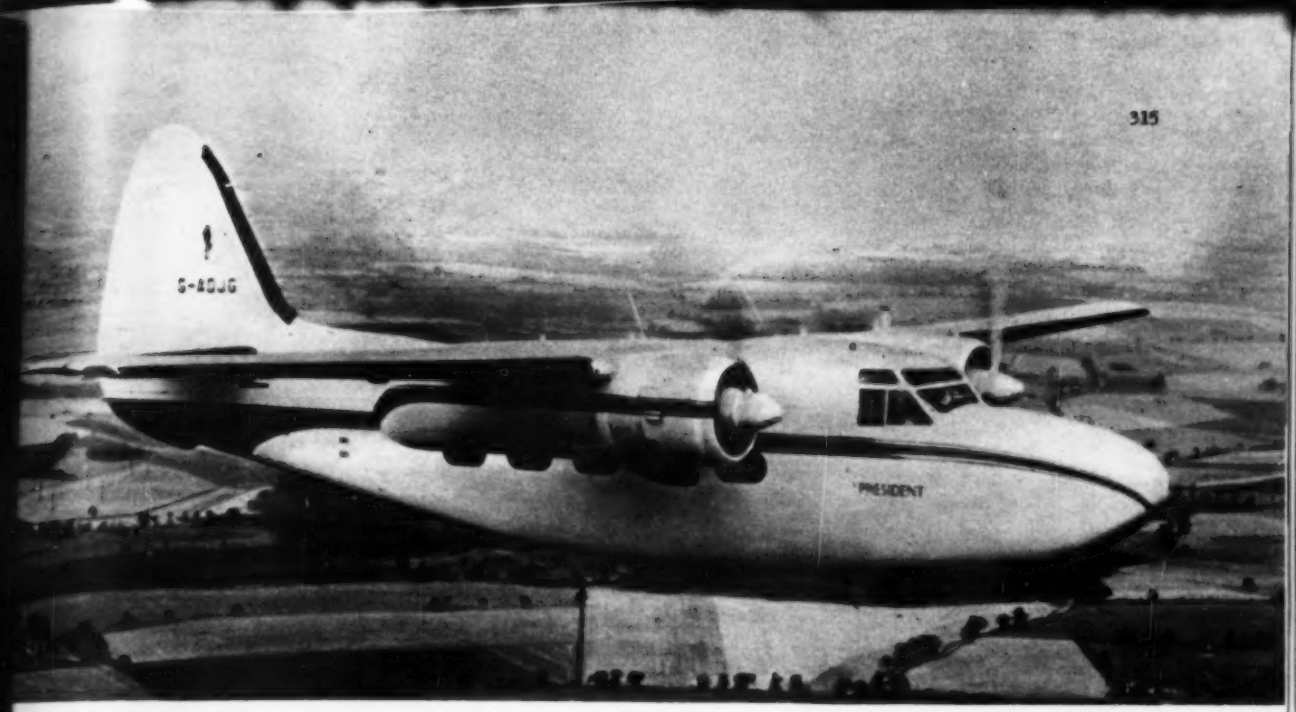
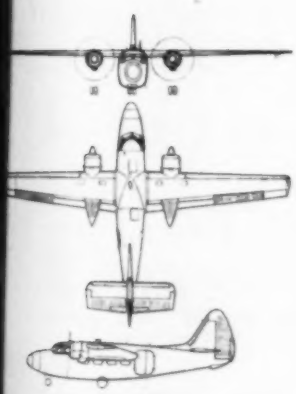




Powerplant	Two Alvis Leonides
Span	64ft 6in
Length	46ft
Gross weight ...	13,500 lb
Economical cruising speed	163 m.p.h.

Photograph above shows President. Drawing shows Pembroke.

and comfortably furnished to carry up to 12 passengers), each Pembroke is quickly adaptable for freighting, supply-dropping, air/sea-rescue, photographic survey, navigation and radio or radar crew-training, casualty evacuation, and twin-engine pilot-training. The cabin volume is particularly large and the aircraft has been cleared for normal operation at an all-up weight of 13,500 lb. Available cabin volume is 620 cu ft, and the measurements are 20ft 1in long, 5ft 6in wide and 6ft high. Five single seats are arranged on each side (either rearward or forward-facing), with a double-seat unit at the rear of the cabin, providing a 12-seater layout. Fixed fittings in the cabin provide for stretchers or for the lashing down of cargo, and the main door is removable for parachuting freight and equipment.

President The President is a civil development of the Pembroke. It has been developed not only for executive use but also to comply with international airworthiness requirements for transports carrying up to 12 passengers and a crew of two. A basic executive layout provides for six seats and two tables, together with a toilet compartment, refreshment cabinet and wardrobe. Other arrangements can be "as luxurious as desired." For survey work the aircraft provides a suitable camera platform at heights of over 20,000ft, and the cabin can accommodate all types of vertical and oblique cameras. For this work oxygen equipment and automatic pilot are provided. In the ambulance rôle up to nine stretchers can be taken.

JACKAROO AIRCRAFT, LTD.

Thruxton Aerodrome, Thruxton, Andover, Hants. Telephone: Weyhill 304

Thruxton Jackaroo Claimed to be the cheapest four-seat aircraft in the world, the Thruxton Jackaroo is a conversion of the de Havilland Tiger Moth. In either crop-dusting or four-seat passenger version it sells at £1,095 complete, with nil engine hours, ex-works. Whichever model is purchased a conversion kit to turn it into the other variant is available for £150. Practically the whole of the original Tiger Moth structure is retained intact, and "Tiger" spares, which are available almost everywhere, can therefore be used. The overhaul life of the engine is 1,500 hr, and overhauls cost £150.

Thruxton Jackaroo.

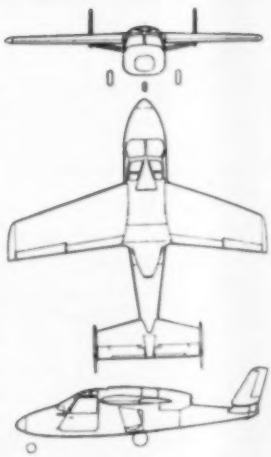
F. G. MILES, LTD.

Shoreham Airport, Shoreham-by-Sea, Sussex. Telephone: Shoreham-by-Sea 2301

Student The essential features of this remarkable little general-purpose jet trainer are seen in the photograph and drawing. Especially notable are the excellent field of view and the ease of exit in an emergency (by jettisoning the wide, floor-level, car-type doors). The standard powerplant is a Blackburn Marboré 2 or a Continental J69, but alternatively two Blackburn Palas 600s can be fitted. (Variants are detailed on page 369.)

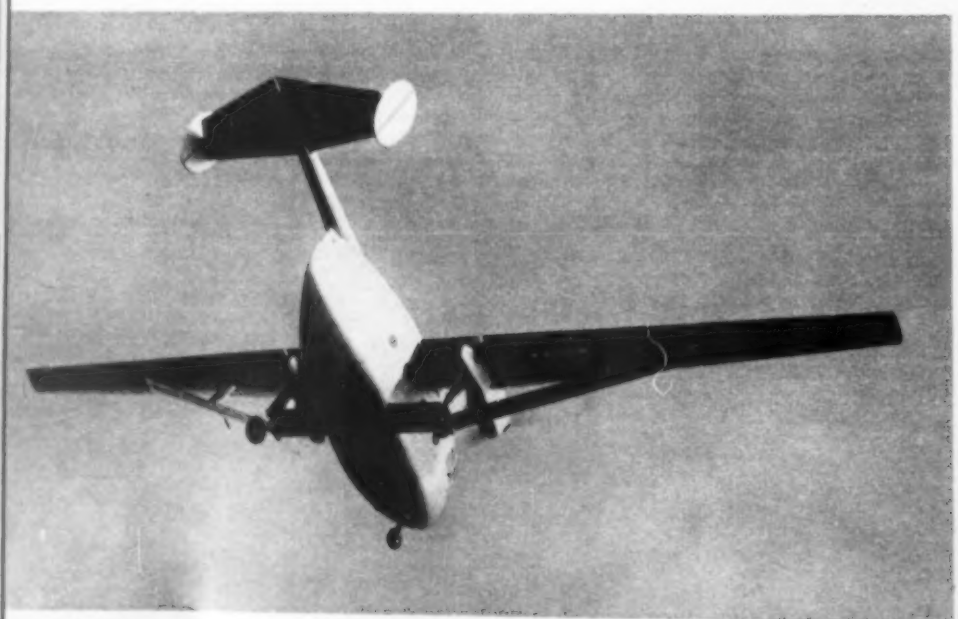
Centurion Mk 4 and Mk 5 These are two higher-powered versions of the Student, respectively with a Turboméca Gourdon and two Turboméca Arbizon. The Mk 4 would have a maximum emergency speed of 430 m.p.h. and a stalling speed of 73 m.p.h.

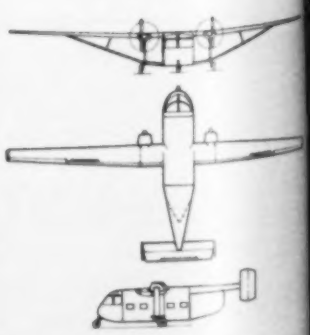
HDM.106 Early in 1955 the Miles company and the Société des Avions Hurel-Dubois decided to collaborate, and having formed a joint company—H.D. et M. (Aviation), Ltd.—set out to prove and demonstrate the efficiency of the H.D. high-aspect ratio wing by applying it to a Miles Aerovan. This aeroplane—the HDM.105—flew in March this year and is seen in the photograph below. The wing is claimed to have conferred "considerable gains in performance." Now in prospect is the HDM.106, shown in the three-view drawing, for which Lycoming GO-480 engines, each of 290 h.p., are intended. Of this type the makers claim that it will be "a more versatile and economical short-haul transport aircraft than any other available or projected at this time."



Powerplant		Blackburn Marboré 2
Span	... ...	29ft 2in
Length	... ...	30ft 9in
Gross weight	... ...	3,600 lb
Max. speed	... ...	302 m.p.h.

Photograph and drawing above show Student.





Powerplant		Two Lycoming GO-480
Span	... ...	75ft 4in
Length	... ...	37ft 10in
Gross weight	... ...	8,000 lb
Max. cruising speed	...	258 m.p.h.

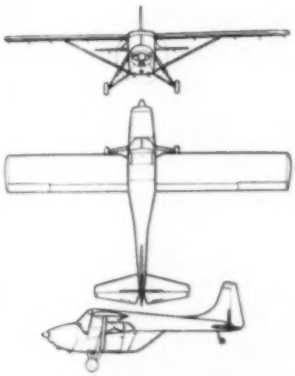
Drawing above shows HDM.106 and photograph at left shows HDM.105.

Right, M.L. Utility Mk 1 during inflation and in flight.

M. L. AVIATION CO., LTD.

White Waltham, Berks. Telephone: Littlewick Green 248

Utility Mk 1 This ingeniously contrived inflatable aircraft was described in some detail in *Flight* of May 31 last. On that occasion it was remarked, "In two years of development under M.o.S. contract the principle of the inflatable wing, originally conceived by the M.o.S. Research and Development Establishment at Cardington, appears to have been well proven." The Utility Mk 1 is the second machine of the kind built and has a two-seat gondola-type open fuselage. The engine is a Walter Mikron. Cruising speed (35 h.p.) is 50 m.p.h. and stalling speed 30 m.p.h. Gross weight is 1,000 lb and wing span 35ft.



Powerplant	Lycoming GO-480B
Span	43ft 6in
Length	30ft
Gross weight	3,050 lb
Typical cruising speed ...	128 m.p.h.

Drawing above and photograph below show E.P.9.

EDGAR PERCIVAL AIRCRAFT, LTD.

Stapleford Tawney Aerodrome, Abridge, Essex. Telephone: Theydon Bois 2321

E.P.9 Orders for this robust agricultural and general-purpose aircraft have now been received from operators in Gt. Britain, Australia, Canada, New Zealand, Germany, Algeria, Libya and Vietnam, and have been delivered at the time of writing. Aside from its primary agricultural role, the E.P.9 can be used as a six-seat passenger transport, as a light freighter, an ambulance, a photographic and survey aircraft, or a military liaison machine. A floatplane version is planned. The fuselage structure is of welded steel tubing, which material obviates the corrosive effect of agricultural fertilisers and sprays. A heavy tubular frame immediately behind the pilots' seats (the cockpit has dual control) takes the main wing spar and undercarriage loads. Of Edgar Percival design, the undercarriage can handle vertical velocities of 9ft/sec. Because of its long travel it is claimed to have better energy-absorption characteristics than many deck-landing gears designed for 11ft/sec. All types of spray equipment can be carried, and in the top-dressing role a ground crew of three can be transported in addition to the pilot and hopper.

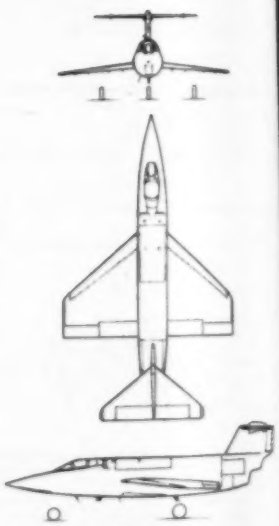
SAUNDERS-ROE, LTD.

Osborne, East Cowes, Isle of Wight. Telephone: Cowes 2211

SR.53 This prototype is one of the most significant military research aircraft to be flown since the war, embodying as it does the "mixed-power" principle of rocket plus turbojet. For the present the de Havilland Spectre rocket unit is supplemented by an Armstrong Siddeley Viper, but there have been references to possible developments with a Gyron Junior instead of the Viper. Interest in such a development has been displayed not only by the German government but by the Royal Navy, and it has been officially stated that it might well be adopted for the Fleet Air Arm. It is the maker's view that an intercepter of this sort, armed with guided missiles, offers the best hope of an effective air defence until such time as *long-range* pilotless surface-to-air missiles have been perfected. They add: "The mixed-unit aircraft fits perfectly into such a defence system. It is mobile and small enough to operate from almost anywhere, even from metal mesh laid in a meadow, and is flexible enough to meet every type of attack. With a lengthy period of radar early warning, it can climb on the power of its turbojet alone, to ensure maximum endurance. When there is little warning, the rocket and jet can be used together to give an extremely rapid rate of climb, followed by the high acceleration to supersonic speed and manoeuvrability at height that are essential for the interception of a modern jet bomber."

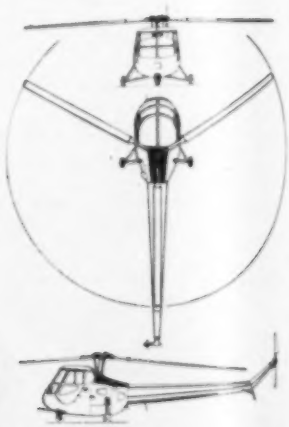
Skeeter The latest of the Skeeter line of light helicopters is the Mk 12, now in production for the British Army and R.A.F. and for the Army and Navy of the Federal Government of Germany. This mark is particularly interesting in respect of powerplant. The basic engine is a Gipsy Major 215, of 215 h.p. A methanol-injection system, which maintains rated engine power at sea level in all air temperatures up to tropical conditions, can be installed if required. Alternatively, an exhaust-driven turbo-supercharger can be fitted. This is readily removed or refitted and enables rated power to be maintained in all climates up to at least 4,000ft altitude. A rocket-boost system, developed in collaboration with D. Napier and Son, Ltd., provides greatly enhanced short-period performance if required.

Reporting an air test of a Skeeter in our issue of July 5 last, the Editor wrote: "For the first time, I felt that here was a machine sufficiently compact, simple, conventionally manoeuvrable and comfortable to challenge the light fixed-wing machine on even terms. . . Of course it can offer a lot more in some respects, while on the other hand it is still considerably slower in cruising flight. But if the price can in time be brought within bounds, this is a type of aircraft I could use and appreciate week-by-week."



Powerplant **de Havilland Spectre and Armstrong Siddeley Viper**

Photograph and provisional drawing above show SR.53.



Powerplant	de Havilland Gipsy Major 215
Rotor diameter ...	32ft
Length (blades folded) ...	28ft 5in
Gross weight (normal) ...	2,250 lb
Max. speed	103 m.p.h.

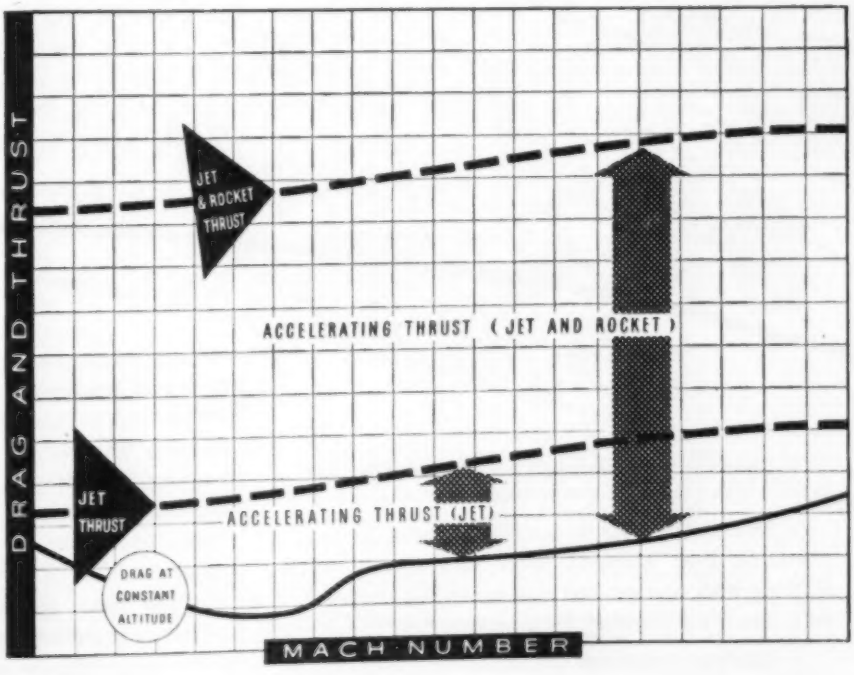
Drawing above shows Skeeter Mk 12; photograph shows Mk. 6.

PERFORMANCE AT ALTITUDE—

THE KEY TO MODERN INTERCEPTION

A significant limit to the effectiveness of interception has formerly been set by the fall-off in thrust of the pure jet at high altitude. Saunders-Roe set themselves to break beyond that limit by the evolution and development of the mixed-unit principle, using both jet and rocket propulsion. The recently demonstrated success in prototype of this development has more than justified the energy with which Saunders-Roe have pursued it.

Consider the mixed-unit principle as applied to ACCELERATION. High maximum speed for an interceptor is essential, but it means little unless acceleration in both forward motion and turning capability is also available. Saunders-Roe have shown the mixed-unit interceptor to possess both these qualities in full measure at modern operational altitudes.



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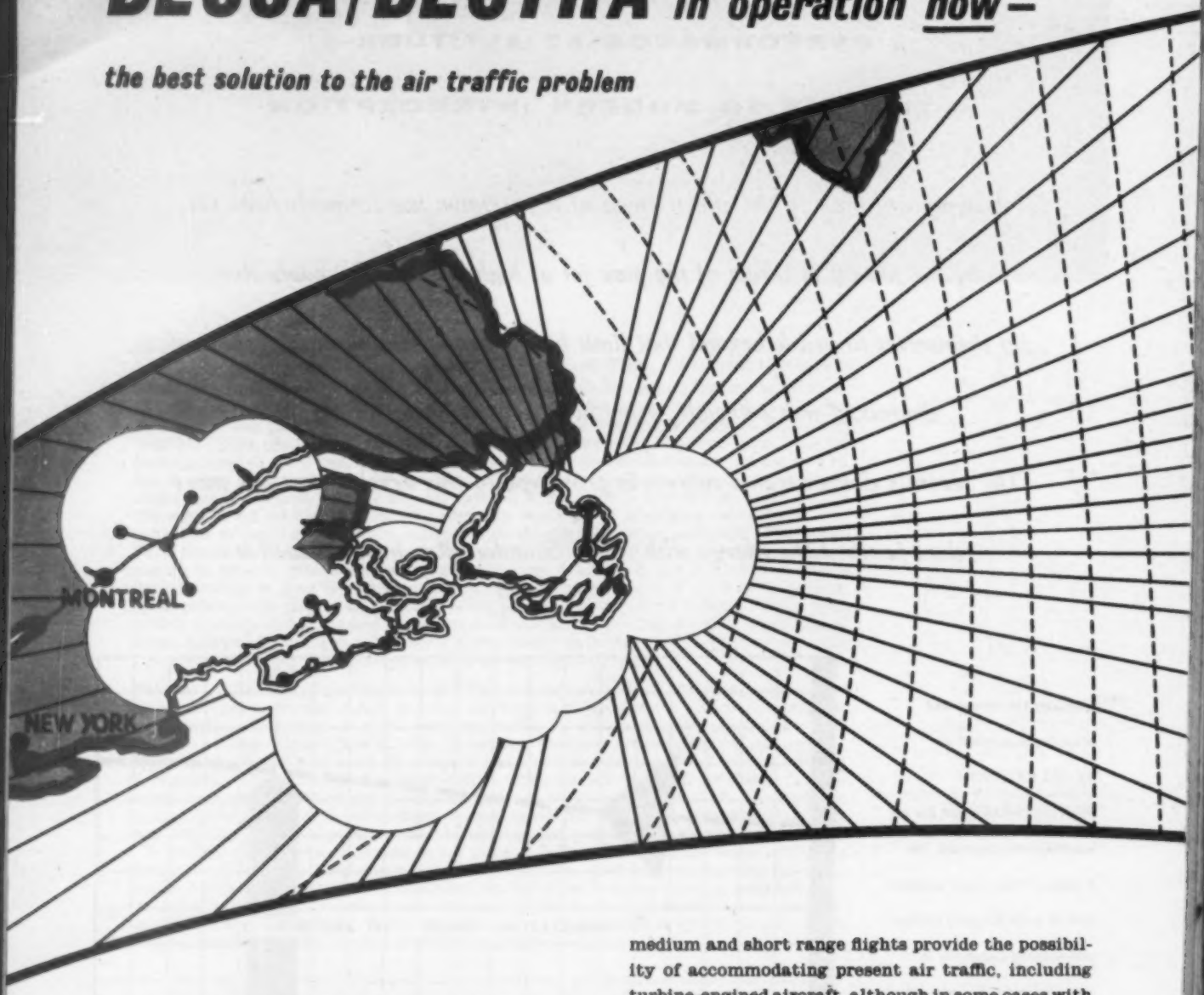


Precise control of air and sea traffic can be accomplished today by the use of Decca/Dectra the proven high accuracy area coverage system.

DECCA/DECTRA is the only navigation system providing high accuracy local coverage at any altitude with medium and long range parallel track facilities using the same airborne equipment.

DECCA/DECTRA is the only system which provides pictorial presentation.

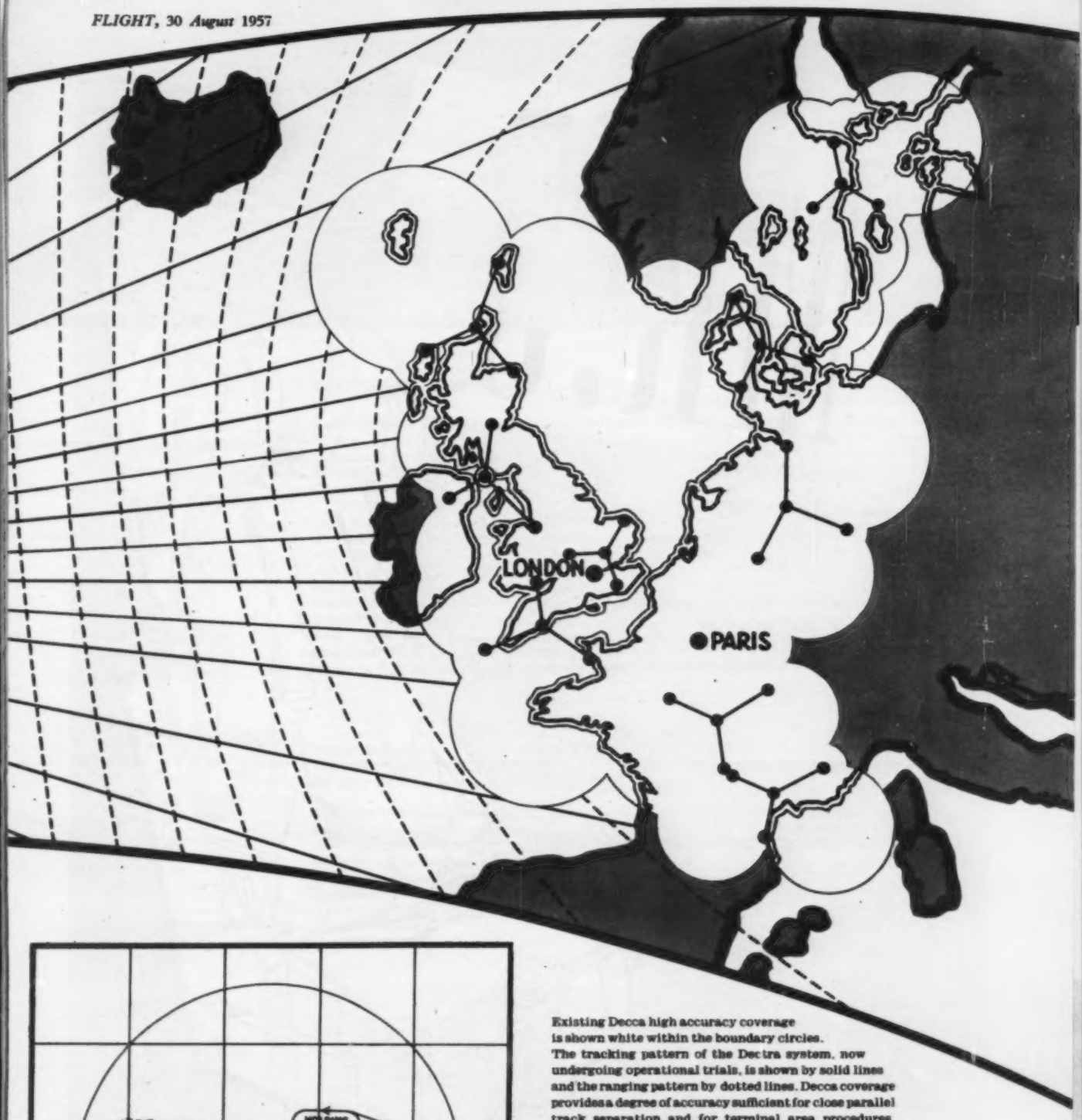
DECCA/DECTRA is the most economical system in the world both in cost and in use of frequencies.

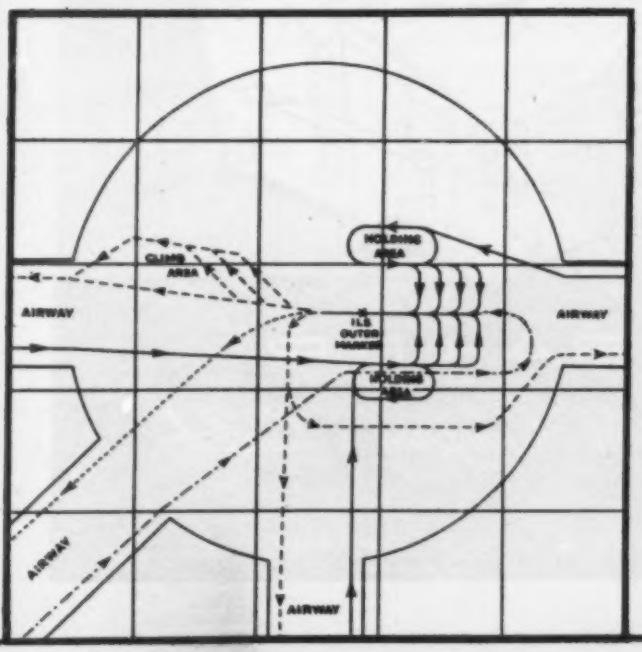
The report of the Jet Operations Requirements Panel of ICAO meeting in Montreal in June 1957 has this to say :

" Some existing systems of navigation used for medium and short range flights provide the possibility of accommodating present air traffic, including turbine-engined aircraft, although in some cases with difficulty. However, increasing traffic densities plus the special requirements for optimum operation of jet aircraft, as outlined in the ATS section of this report, lead to the conclusion that an area type of navigation aid will be necessary in the near future.

The Panel recommends the adoption of an accurate and reliable short-range navigational aid based on the area coverage system and designed to provide pictorial presentation to the pilot in the cockpit. The Panel further recommends that the Sixth Session of the Communications Division should consider this recommendation as a matter of urgency."

Over 4,000 ships and aircraft are fitted with the Decca System which has been in operation for over 11 years.





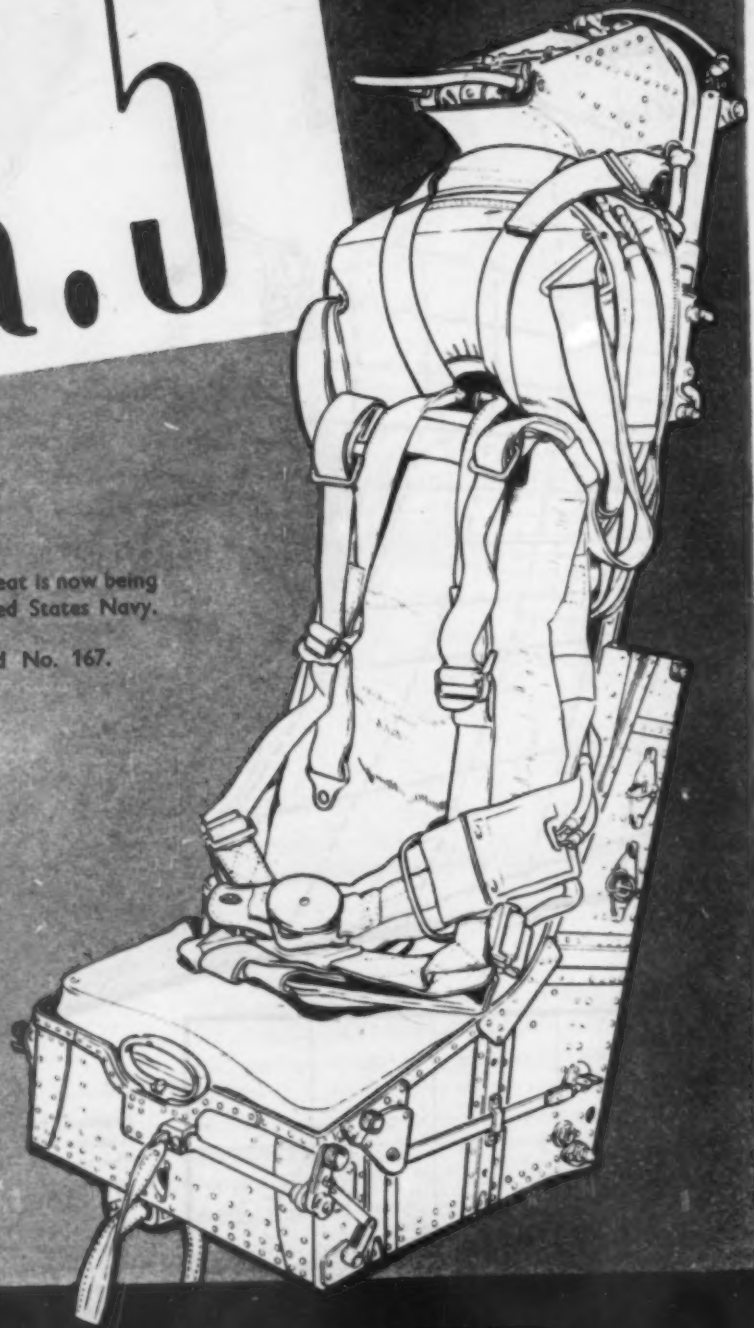
Existing Decca high accuracy coverage is shown white within the boundary circles. The tracking pattern of the Dectra system, now undergoing operational trials, is shown by solid lines and the ranging pattern by dotted lines. Decca coverage provides a degree of accuracy sufficient for close parallel track separation and for terminal area procedures. Decca area coverage combined with the pictorial presentation of the Flight Log is the best answer to the ATC problem both en route and in terminal areas. An example of a terminal control zone flight path pattern based on Decca is shown on the left.

DECCA/DECTRA

the world's most accurate navigation system

THE DECCA NAVIGATOR COMPANY LTD LONDON

Mk.5



The Martin-Baker Mk.5 Ejection Seat is now being delivered in quantity to the United States Navy.

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Aircraft Company Limited

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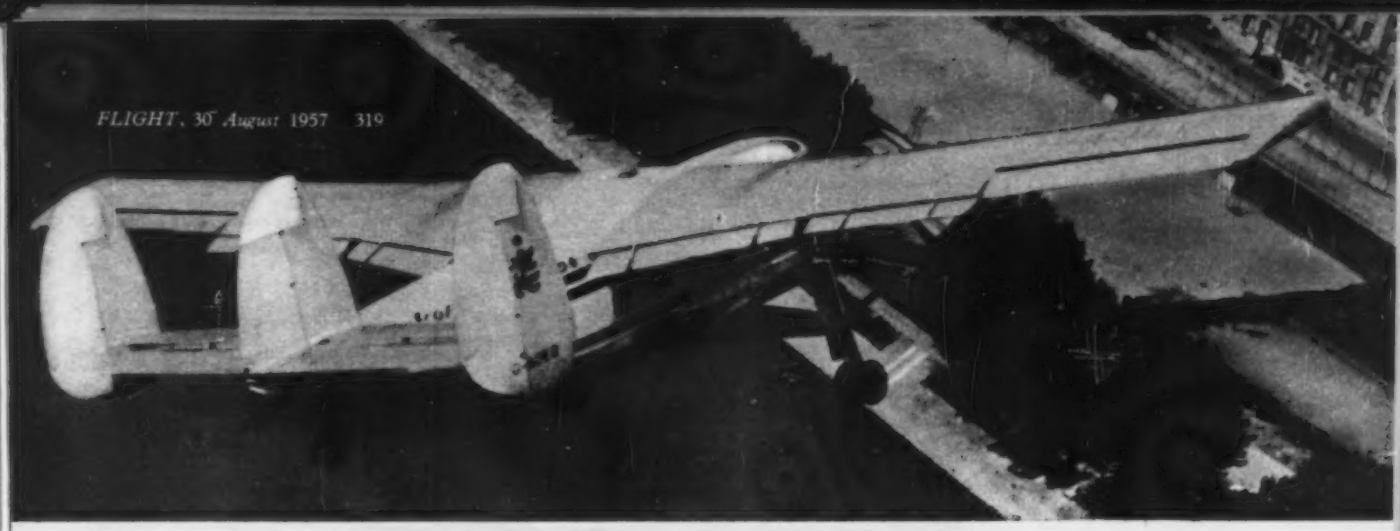
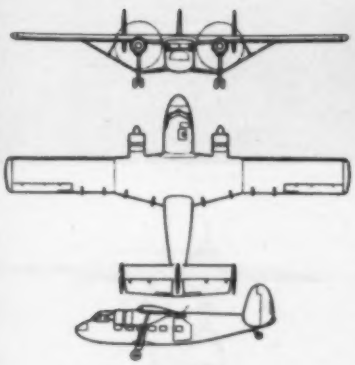


SCOTTISH AVIATION, LTD.

Prestwick Airport, Ayrshire. Telephone: Prestwick 79888



Powerplant	Two Alvis Leonides 504/8
Span	76ft 6in
Length	45ft 3in
Gross weight	13,500 lb
Typical cruising speed ...	134 m.p.h.

Photograph and drawing above show Twin Pioneer.

Twin Pioneer Very extensive demonstration tours have reaffirmed world-wide interest in this unique short-take-off-and-landing aeroplane, and during the past year it has been announced that the type has been ordered in production for the Royal Air Force for deployment in the Middle East and Far East theatres. This military version will have provision for armament.

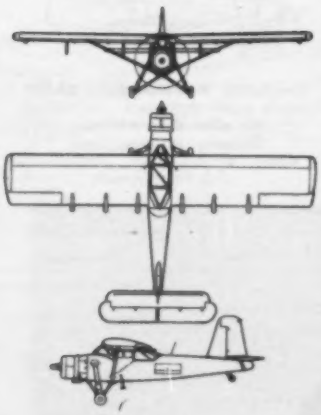
Although two Alvis Leonides engines are standard equipment, Pratt and Whitney Wasps have been specified by Philippine Airlines. The increased power (600 h.p.) gives improved performance in spite of an additional 1,000 lb in gross weight, and the Philippine company will equip their Twin Pioneers with 20 seats instead of 16.

The raison d'etre of the Twin Pioneer is summarized by the makers as follows: "The basic design philosophy . . . was to produce aircraft capable of using unprepared surfaces in restricted spaces, thereby providing the means of extension of services to those areas in which it would be either uneconomical to provide the necessary runways for the operation of aircraft with higher take-off and landing speeds such as are in general use today, or where geographical conditions were such that normal length runway strips are just not possible. In addition it was felt that such an aircraft had many potential uses in the military field in the transport of troops and equipment into areas remote from points where such troops and equipment would be landed on main airfields by the larger long-range military transports."

Handling characteristics are uncommonly docile. *Flight's* report of an air-test observed: "The stall is rather a joke. With take-off flap and no power, the Pioneer gets slower and slower and slower. Finally, with wheel on the back stop, it gives a slight shrug as if to say 'Since you insist,' and then gently bows in submission, with wings level, and continues in its glide with the nose a few degrees lower. . ."

Pioneer Single-engined forerunner of the Twin Pioneer (Alvis Leonides engine), this type continues to show its mettle in R.A.F. service—particularly in support of Malayan operations. It was reported in the Air Estimates this year that Pioneers of the R.A.F. had been flying an average of 600 sorties each month.

Turbo-Pioneer This name is tentatively applied to a projected Scottish Aviation STOL aircraft, having a retractable undercarriage, rear-loading possibilities and two Rolls-Royce Dart turboprops.



Powerplant	Alvis Leonides 502/4
Span	49ft 9in
Length	34ft 4½in
Gross weight	5,800 lb
Max. speed	162 m.p.h.

Drawing above and photograph at right show Pioneer.

SHORT BROTHERS AND HARLAND, LTD.

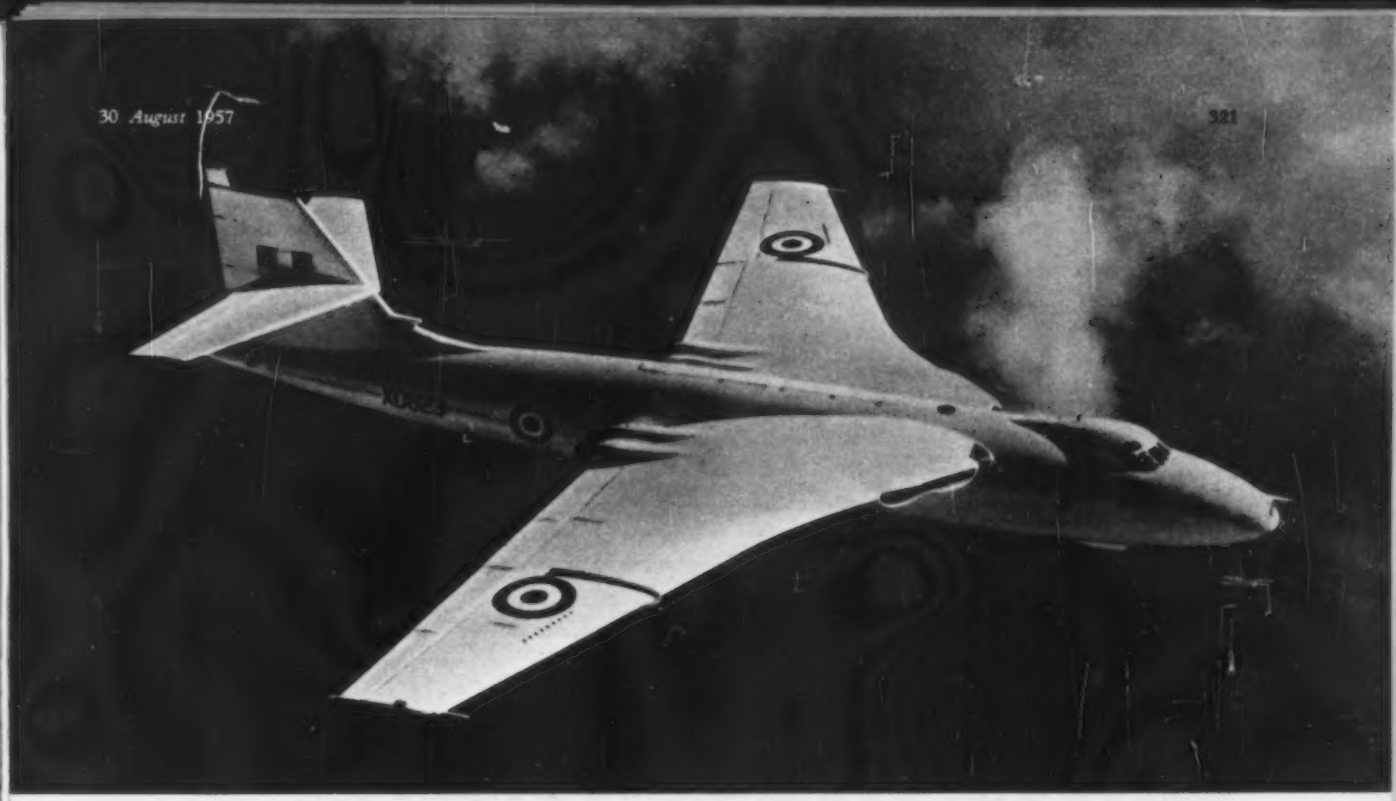
Queen's Island, Belfast, N. Ireland. Telephone: Belfast 58444

SC.1 Few companies can have greater experience in the design and construction of specialized research aircraft than have Short Brothers—this in addition to development and production of conventional, but none the less important, machines. At the present time, parallel with their production of Bristol Britannias and with the design of special Britannia features such as the "floating floor" of the military Series 253, this old-established company is proceeding with the development and testing of the SC.1 vertical-take-off-and-landing delta. Also in hand is the final stage of the S.B.5 programme (the S.B.5 was used as an aerodynamic test vehicle for the English Electric P.1) calling for the installation of a Bristol Orpheus turbojet and the sweeping of the wings to their ultimate angle of 69 deg.

In reference to the SC.1, a Short Brothers' engineer has said that the fundamental problem to be solved is that of stability and control in hovering and transition flight, and the development of techniques of making transitions from hovering to wing-borne flight and vice versa. Power is provided by five Rolls-Royce RB.108 engines, one of which is apparently mounted conventionally, fed from a dorsal intake and having a rearward-facing jet-pipe to provide forward propulsion. The other four are thrust downwards through the bottom of the fuselage. Short Brothers recognize that it is difficult to assess what shape future aircraft are likely to take, but of the well-tried configurations a tailless delta seemed likely most nearly to represent the sort of low-speed aerodynamics that would have to be dealt with. In addition to the aerodynamic features of the SC.1 it was necessary to have a light structure since, being a research aircraft, the machine had to do everything a normal aircraft would do, plus having the ability to take off and land vertically, and to carry a substantial amount of test equipment. It is interesting to relate the work of Short Brothers on the SC.1 to the Air League proposal for a highly supersonic "paper dart" V.T.O. airliner.

Powerplant Five Rolls-Royce RB.108

No other data available.
Drawing is provisional.



Powerplant			Four Rolls-Royce Avon
Span	...	...	114ft 4in
Length	...	...	108ft 3in

Photograph and drawing above show Valiant B.1.

VICKERS-ARMSTRONGS (AIRCRAFT), LTD.

Vickers House, Broadway, London, S.W.1. Telephone: Abbey 7777

Valiant B.1 Royal Air Force Bomber Command now has its full complement of Valiant B.1s. These include a number of B(PR)K.1s, which can be used for bombing and photographic reconnaissance, and also as tankers for flight-refuelling. Since the last S.B.A.C. Display it has become possible for members of the Press to fly in Valiants, and our own representative wrote as follows: "We were taking off at about 120,000 lb, the bomb bay empty and the aircraft with much less than full fuel load. The nosewheel was lifted at 80 kt, acceleration check-point speed was 110 kt and unstick speed 112 kt—a long, long way before the end of the 3,000-yd runway. At over 2,000ft/min, we climbed at 190 kt till 20 deg flap setting and wheels were cleaned up and then the climb was begun at 4,000ft/min and 275 kt, reducing to 240 kt at 30,000ft and 230 kt at 40,000—exactly. The cruise climb was begun at 43,000ft with 7,350 r.p.m. and 0.75 Mach—exactly. All the way up we checked pressure and oxygen. We wore A13-A pressure-breathing masks, but used the cruise pressure setting of 9 lb/sq in differential, giving 9,000ft cabin height at all aircraft heights above 30,000ft. . . .

"The A.S.I. read 215 kt as we drifted up in the cruise; the calculated T.A.S. was 430 kt and a dial showed a groundspeed of 425 kt with two or three degrees of drift. It all seemed so effortless until I remembered the experience, training and detailed preparation which lay behind every move and thought. We knew with amazing precision where we were and where we had to go. The cabin was at just the right temperature for our shirtsleeves-and-flying-suit garb; and remained so throughout.

"As we drifted up to 46,000ft the sky began to get deep blue and lightless. A shaft of brilliant sunlight illuminated part of the navigator's plotting chart, but an electric desk-lamp was needed to see the rest of it. Most light came from the cloud-layers far below. I climbed down into the bomb-aimer's visual sighting position, under a trapdoor (my oxygen pipe and intercom lead allowed me this freedom) and lay looking down at a kaleidoscope of cloud and land moving past at about eight miles a minute. Still drifting up past 47,000ft, now with an I.A.S. of 190 kt, I drank a tin of orange juice and then climbed on to the sharp edge of the navigator's seat for another look at the pilots' picture. At full arm's length I grasped the control wheel and was allowed to make a couple of 30 deg-banked turns. It was effortless and precise . . ."

The last of the production Valiants was to be flown out of Brooklands airfield on August 27. The Valiant's ability to depart from that small aerodrome is in itself testimony to its take-off qualities. These can be further improved by the use of de Havilland Super Sprite jettisonable rocket packs.

VC-10 Few details of this 600 m.p.h.-plus medium jet transport project have been released, except that it is to be powered by four Rolls-Royce Conways and is intended to carry "very large payloads" (up to 147 passengers) on medium-range routes. The British Overseas Airways Corporation has stated its intention to order a fleet of 35 VC-10s for its Commonwealth routes. "Certain unusual features" are aimed at good airfield performance, and the fuselage will be of "double-bubble" design, with big freight holds, similar to that of the Vanguard (see page 323).

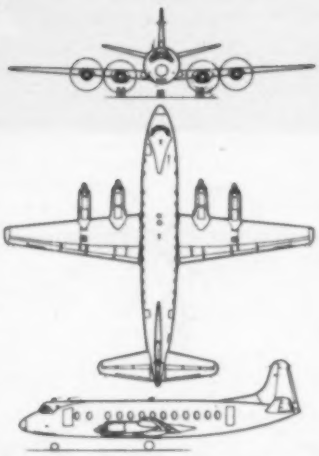
Deliveries of VC-10s will be made in 1963. The development of the aircraft is to be privately financed.

Viscount 800 The Vickers Viscount is represented at this year's S.B.A.C. Display by a type-800 for K.L.M., similar to the 800s in service with B.E.A. and Aer Lingus, and in production for the N.Z.N.A.C., Transair and Eagle Aviation. The 800 may be regarded as the second major development of the basic Viscount 700, the first being the higher-powered 700D. The 800 has the same higher-powered engines (Rolls-Royce Dart 510s of 1,600 s.h.p.), as the 700D, but increased cabin length with accommodation for ten more seats—up to 63 compared with up to 53 in the 700 and 700D.

The 800 is, however, already being closely followed on the Weybridge production lines by the newest member of the family, the model 810/840. This is basically an 800 with increased performance: fitted with 1,800 s.h.p. Dart 525s, the 810 cruises at 355 m.p.h. (40 m.p.h. faster than the 800 and 700), and it is structurally capable of true 400 m.p.h. cruising when the forthcoming 2,100 s.h.p. Dart 541s are installed. In this guise the 810 becomes the 840—the first 400 m.p.h. Viscount.

First deliveries of the 810/840, to Continental Air Lines of the U.S.A., will start early in 1958. In the meantime, an 806 for B.E.A. has been fitted with Dart 525s, making it representative of the 810 (see photograph below), to accelerate the test programme.

A good measure of a transport aeroplane's success is provided by actual figures of operating cost achieved in airline service. Figures just issued in the U.S.A. for Capital Airline's fleet of 59 Viscounts show a direct operating cost of 75.80 cents per mile and a maintenance cost of $34.45 per hour. The interesting point about these costs is not so much that they correspond

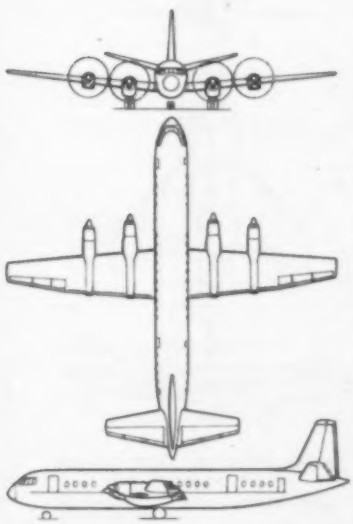


Powerplant	Rolls-Royce Dart 525
Span	94ft
Length	85ft 5in
Gross weight	67,500 lb.
Typical cruising speed	365 m.p.h.

Drawing and data above, and photograph below left, refer to Viscount 810. Drawing and data below refer to Viscount 700D. Heading photograph shows K.L.M. 800.

Powerplant	Rolls-Royce Dart 510
Span	93ft 8in
Length	81ft 2in
Gross weight	63,000 lb
Typical cruising speed	325 m.p.h.

Powerplant	Rolls-Royce Tyne 2
Span	111ft
Length	122ft 10in
Gross weight	141,000 lb
Typical cruising speed ...	425 m.p.h.



almost exactly with Capital's original estimates, but that they compare remarkably favourably with the long-established piston transports. For example, corresponding figures for the DC-6B were 110.47 cents per mile and $59.56 maintenance cost per hour. Similar figures for the Convair 340/440 were 77.18 cents and $37.04.

No doubt the biggest contribution to the Viscounts' success has been made by the Rolls-Royce Dart. With more than two million engine hours flown, the authorized overhaul period is now 1,500 hrs, with 2,000 hrs as the goal. Statistics for 1956 show that the average feathering rate was 0.5 per 10,000 hr, and the average failure rate 1.3 per 10,000 hr (most of the latter being revealed during ground inspection). These figures for the only turbine engine in service at that time compare favourably with the best piston-engine records.

Not all Viscounts have been ordered for airline use, and several are now in service with executive owners.

Of the 372 Viscounts sold to date, 225 have been delivered. Production at Hurn (700s and 700Ds) and Weybridge (800s and 810s) is now at the rate of 12 aircraft per month.

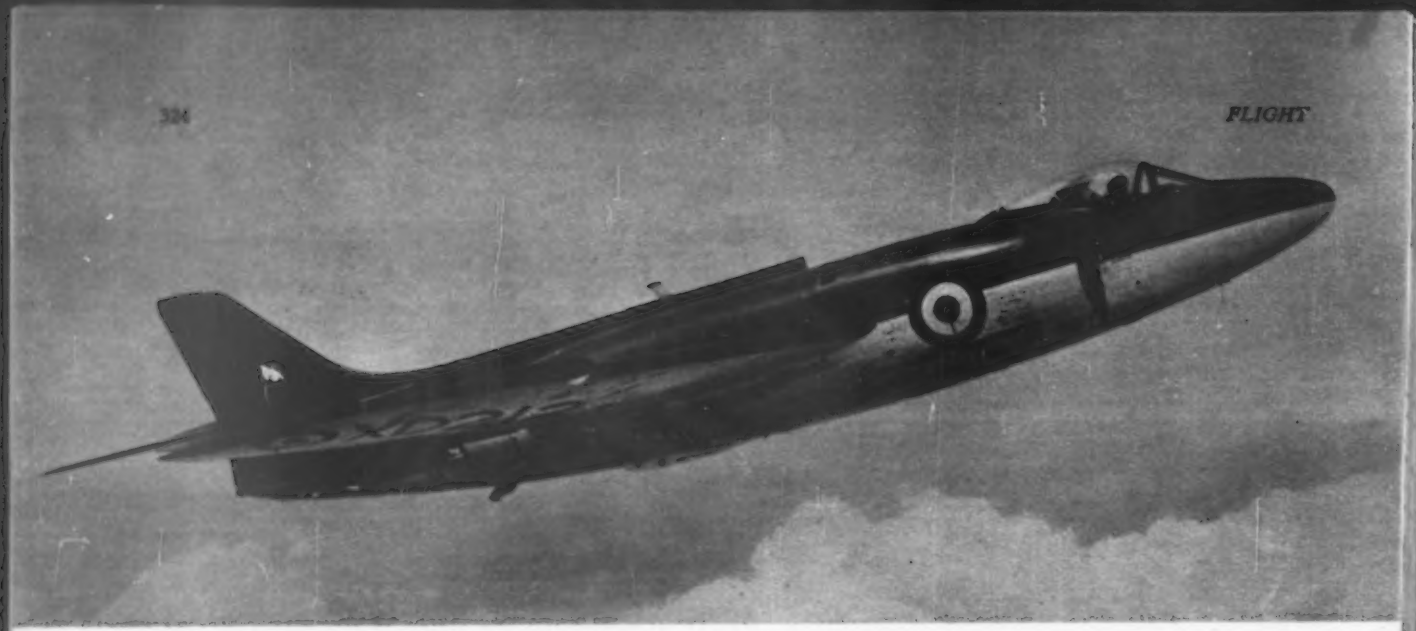
Vanguard To see the full-scale Vanguard mock-up at Weybridge, or the production fuselage-sections now taking shape there, is to realize that this aircraft is very much more than the "bigger Viscount" popularly visualized. With a total fuselage capacity for passengers and freight approaching that of the Douglas DC-8, and an operating cost which promises to be unbeatable over short and medium ranges, the Vanguard is the expression of B.E.A.'s desire for the "ideal" transport for the profitable operation of short-stage, high-traffic-density networks. The aircraft is also having built into it all that Vickers and Rolls-Royce—whose Tyne turboprop was conceived specifically for the aircraft—have learnt in their experience of the North American market with the Viscount. The first export order for Vanguards, for 20 aircraft, came from Trans-Canada Air Lines, and a large number of airlines have the aircraft high on their lists of the alternative types being studied for their medium-stage and short-haul requirements of the sixties. Indeed, the aircraft falls into the most keenly contested of all transport-aircraft markets today: no less than six other types, jet and turboprop, are being offered as the ideal solution to the airlines' medium transport problems. Every operator has different needs and local conditions, but the majority concur on a set of basic requirements. These may be summarized as follows:

(1) Low operating cost per seat-mile over stage-lengths as low as 200 miles. (2) The ability to carry full payload and fuel reserves on stages of up to 2,500 miles, thus employing one basic vehicle for a route-system with widely varying stages. (3) Large payload capacity, to exploit most economically the rising traffic volume of the years ahead. (4) High block speed and a design engineered for fast terminal turn-round. (5) Modest airfield demands. (6) Economics which are not over-sensitive to the delays inevitably likely to be experienced in the congested traffic of the sixties. (7) Ability to carry a large proportion of capacity payload in off-peak passenger periods, in order to maintain high utilizations—in other words, big freight-hold volume. (8) Systems, engineering, instrumentation and cockpit layout to conform with modern principles.

The Vanguard has been designed to meet these basic airline requirements. An example of the last-named can be seen on the Vickers stand, where a full-scale mock-up of the cockpit—which must be the most practical yet designed for a British airliner—will be on display.

The first production Vanguard is due to fly in about a year's time, with deliveries of B.E.A.'s 20 starting in March 1960. Early aircraft will have Tyne 1 engines of 4,220 s.h.p. each; new orders will be for aircraft with Tyne 2s of more than 4,600 s.h.p., giving a cruising speed of 425 m.p.h. Development of the Tyne up to 5,000 s.h.p. is planned.

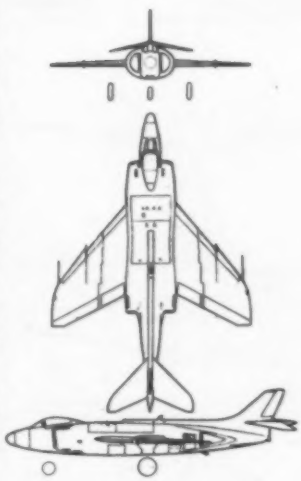
The standard seating arrangement of the Vanguard is 86 (50 tourist and 36 first-class), but up to 130 seats can be accommodated. By virtue of its big freight holds, the aircraft can carry capacity payload with only a quarter of the seats occupied.



VICKERS-ARMSTRONGS (AIRCRAFT), LTD., SUPERMARINE WORKS

South Marston, Swindon, Wilts. Telephone: Swindon 3451

Powerplant				Two Rolls-Royce Avon
Span	...	...	...	37ft 2in
Length	...	...	...	56ft 2in



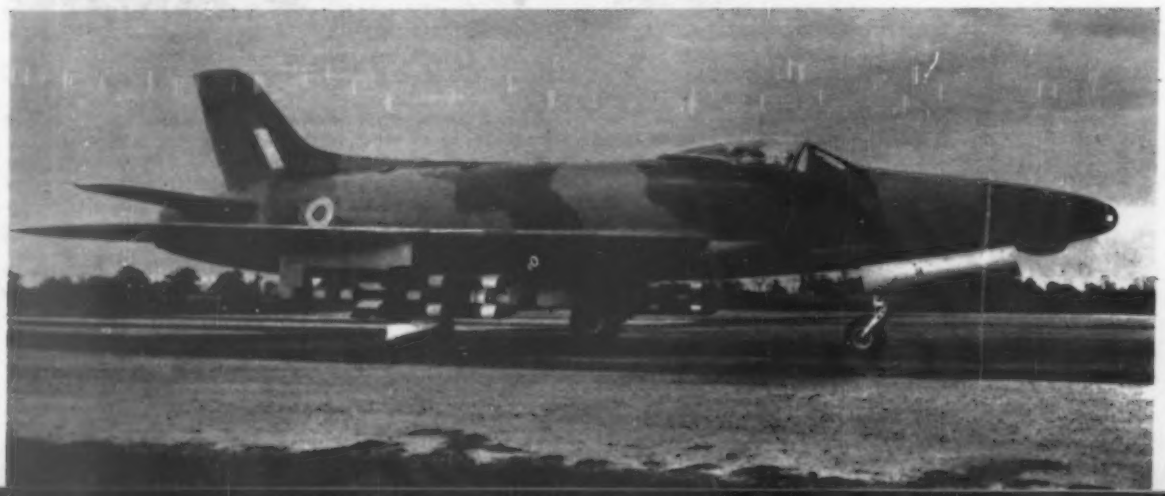
Scimitar Bearing the Supermarine type number 544 and the official specification number N.113, the Scimitar is a carrier-borne fighter/bomber now in production for the Fleet Air Arm. Several examples are already flying. The first production aircraft completed acceptance deck-landing trials aboard H.M.S. *Ark Royal* in July last. Powered with two Rolls-Royce Avon turbojets, the Scimitar, when operating in the strike rôle, can carry a tactical atomic bomb, and the possibility of equipping later models (in the fighter condition) with de Havilland Firestreak guided missiles is being investigated. For strike work a probe for in-flight refuelling can be installed. The built-in armament is four 30 mm Aden guns.

All production models of the Scimitar will be fitted with "blown" flaps which, as deck-landing trials have shown, much improve the machine's handling characteristics and achieve an appreciable reduction in the approach and catapult-launching speeds. These factors are, of course, particularly important in the operation of carrier-borne aircraft. Known to the Supermarine company as "supercirculation," the blown-flap system is operated by high-pressure air fed from each Avon compressor to the top surface of the wing flaps, through a spanwise slot along the rear of the wing in the flap shroud. The effect of this high-velocity air is to delay the onset of turbulence and consequent loss of lift in the air stream over the wing at high angles of attack and low speeds. "Blow" is obtained automatically for the pilot when the flaps reach 10 deg, or it can be manually selected.

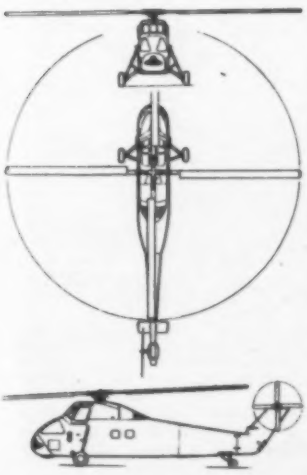
Although the Scimitar does not achieve supersonic speed in level flight, it readily does so in a very shallow dive, as was demonstrated with dramatic effect on the occasion of the Paris Salon earlier this year, when the aircraft arrived over Le Bourget airport almost simultaneously with its bangs. To permit uninhibited manœuvring in thick turbulent air at low levels while carrying heavy loads of strike weapons, the structure is extremely sturdy.

Swift Swifts of the marks F.R.5 and F.7 are serving with the Royal Air Force. The former is a fighter/reconnaissance aircraft and has proved outstandingly successful in recent Continental exercises. The F.7 is to equip a Royal Air Force trials-and-development squadron and is adapted to carry two or four Fairey Fireflash guided missiles. Gun armament has been totally removed and been replaced by fuel tanks. This mark of Swift is larger, both in span and length, than the F.R.5.

Swift F.7 armed with two Fairey Fireflash guided missiles.

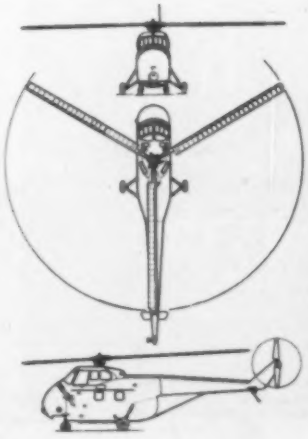


Powerplant	Napier Gazelle
Overall length	65ft 9in
Gross weight	12,600 lb.
Cruising speed	127 m.p.h.



Drawing and photograph below show Whirlwind Mk 5.

Powerplant	Alvis Leonides Major
Rotor diameter	53ft
Fuselage length	41ft 8½in
Gross weight	8,000 lb
Cruising speed	86 m.p.h.



WESTLAND AIRCRAFT, LTD.

Yeovil, Somerset. Telephone: Yeovil 1100

Wessex The Wessex is a much-developed version of the American Sikorsky S-58 and is now in production primarily for anti-submarine operations with the Royal Navy. Powered with a Napier Gazelle gas turbine, it possesses a very fine performance and excellent load-carrying qualities. The Gazelle at present installed is the NGa.11 of 1,100 s.h.p., but the intended unit is the NGa.13, of 1,450 s.h.p. On the occasion of a demonstration of the Wessex a few weeks ago *Flight* reported: "Westlands acknowledge their good fortune in having a gas turbine like the Gazelle available. The union was fortuitous rather than planned. The Royal Navy needed a helicopter capable, in general terms, of doing twice the job of the S-55 Whirlwind—better expressed, perhaps, as the job hitherto handled by a hunting-and-striking pair. The Navy also wishes to clear its ships of petrol in favour of all-paraffin fuel. Unlike the Whirlwind, with four-wheel undercarriage, the Wessex has a tailwheel tricycle."

Civil developments are intended and in this connection it may be noted that the machine is exceptionally quiet. The main sound—a whirring—comes from the tail rotor, now clearly heard for the first time. Twelve seats, arranged in three pairs and two three-abreast, are proposed. In respect of the civil version, the makers point out that the absence of vibration and the reduction in noise level—both due to the Gazelle—not only gives passengers a smoother ride but effects a very considerable reduction in the wear and tear of the transmission system and main components, such as the rotor head and gearbox, giving them a longer overhaul life and, in turn, leading to reduced operating costs.

Whirlwind A notable Westland contribution to the 1956 S.B.A.C. Display was the Mk 5 Whirlwind, with the Alvis Leonides Major engine. Since that time the company has been at work on a batch of Whirlwind Mk 7s—similarly powered—for the Royal Navy, and these were handed over for the equipment of the Helicopter Flight of No. 700 Squadron during June. The Mk 7 is thus the first of the Whirlwind series to enter service with the larger Alvis unit. It has been developed to carry equipment and weapons "capable of locating, seeking out and destroying a submarine."

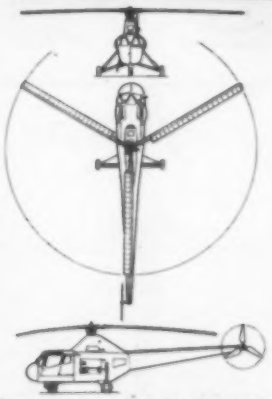
The photograph below shows a civil demonstrator version of the Whirlwind with the Leonides Major engine. A sister machine will be flown at Farnborough this year. Up to ten passengers or freight loads of as much as a ton can be carried.

Widgeon By using the rotor head of the larger Whirlwind the c.g. operating range of the Widgeon has been increased in comparison with that of the Dragonfly, from which it is descended. A five-seater, the Widgeon can be converted into an ambulance for the carriage of two standard stretchers. This operation is accomplished by removal of the three rear seats and by repositioning the front passenger seat, behind the pilot, so that it becomes available for a doctor or a nurse. The Widgeon can be fitted with an hydraulically operated winch hoist which can lift two persons simultaneously for air/sea-rescue operations.

Westminster This massive helicopter will fly initially with a steel-tube fuselage which will act simply as a dimensionally accurate frame for the powerplant and transmission sections of the definitive transport version. This utility version, however, will also be offered for service as a flying crane. It will be fabric-covered. The main transmission, rotors and duplicated hydraulic control system of the American Sikorsky S-56 will be retained, but the outrigger-mounted piston engines are being replaced by later Napier Eland, mounted side-by-side over the cabin and driving directly into the main transmission gearbox. The greater smoothness of these engines will allow a gearbox overhaul life of 1,000 hr. The all-metal rotor blades, built up from extruded spars and having honeycomb-stabilized trailing edges, will offer a fatigue life of 2,000 hr. Hot air de-icing for both main and tail rotors will be available. A simple fixed undercarriage is specified.

The cabin will be 35ft long and 6ft 6in high and have a maximum width of 10ft, giving a cabin volume of 1,780 cu ft. Two loading doors will be provided and the floor will be stressed for concentrated loads. Jury struts are to transfer loads from the 15,000 lb sling directly to the rotor mounting platform to avoid stressing the fuselage during flying crane operations. The fuel load will be 920 Imp. gal and military load 43 fully equipped troops, 31 stretcher cases, or four jeeps in the sling.

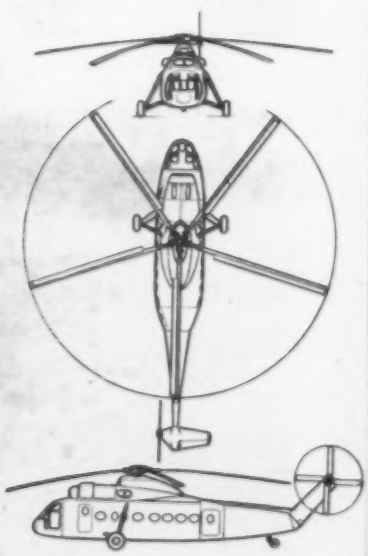
Empty weight of the Westminster will be 20,000 lb, disposable load 13,000 lb and gross weight 33,000 lb. The overload weight will be 36,000 lb. At normal gross weight this most impressive helicopter will have a single-engined rate of climb of 600ft/min.

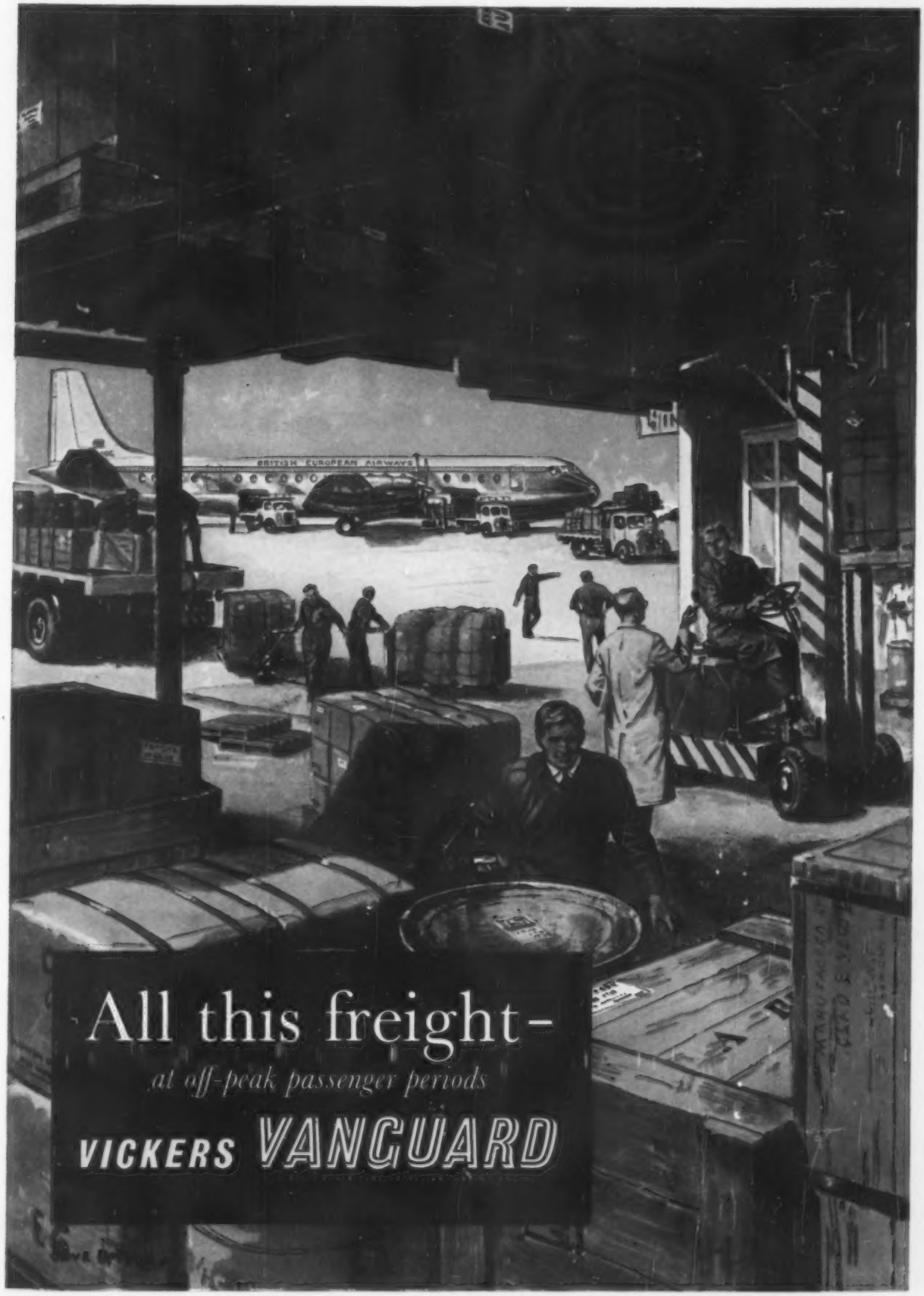


Powerplant	Alvis Leonides 521/1
Rotor diameter	49ft 2in
Fuselage length	41ft 3in
Gross weight	5,900 lb.
Max. cruising speed ...	101 m.p.h.

Photograph and drawing above show Widgeon. Artist's impression and drawing below show Westminster.

Powerplant	Two Napier Eland
Rotor diameter	72ft
Overall length	86ft 9in
Gross weight	33,000 lb.
Cruising speed	150 m.p.h.

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All this freight–
at off-peak passenger periods
VICKERS VANGUARD

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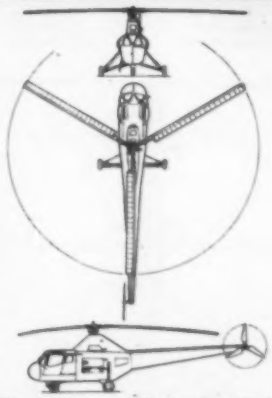

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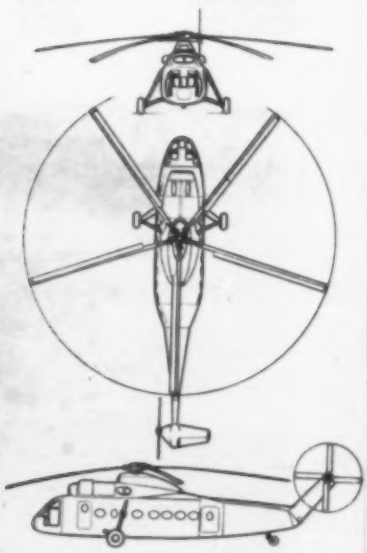

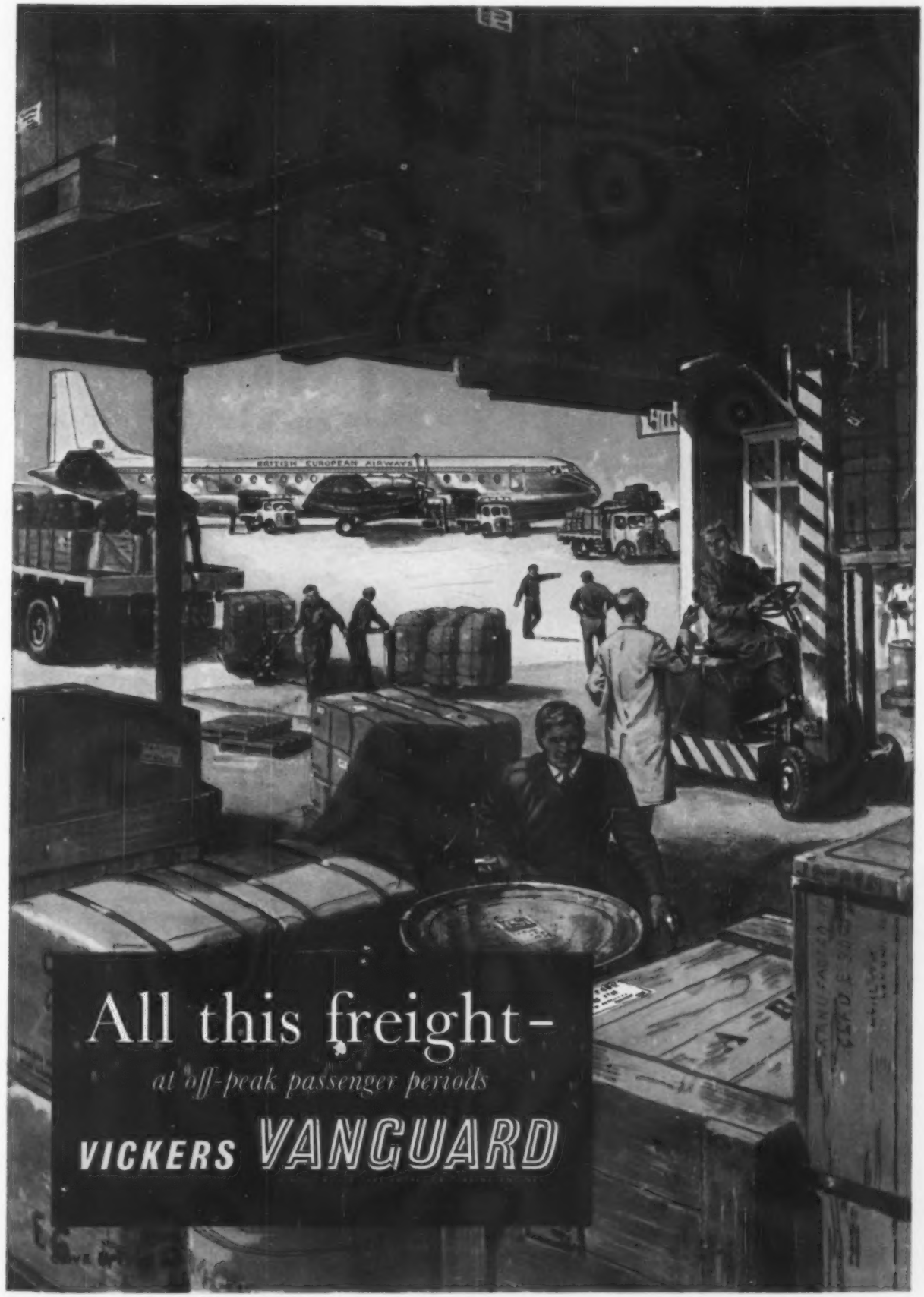
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at off-peak passenger periods
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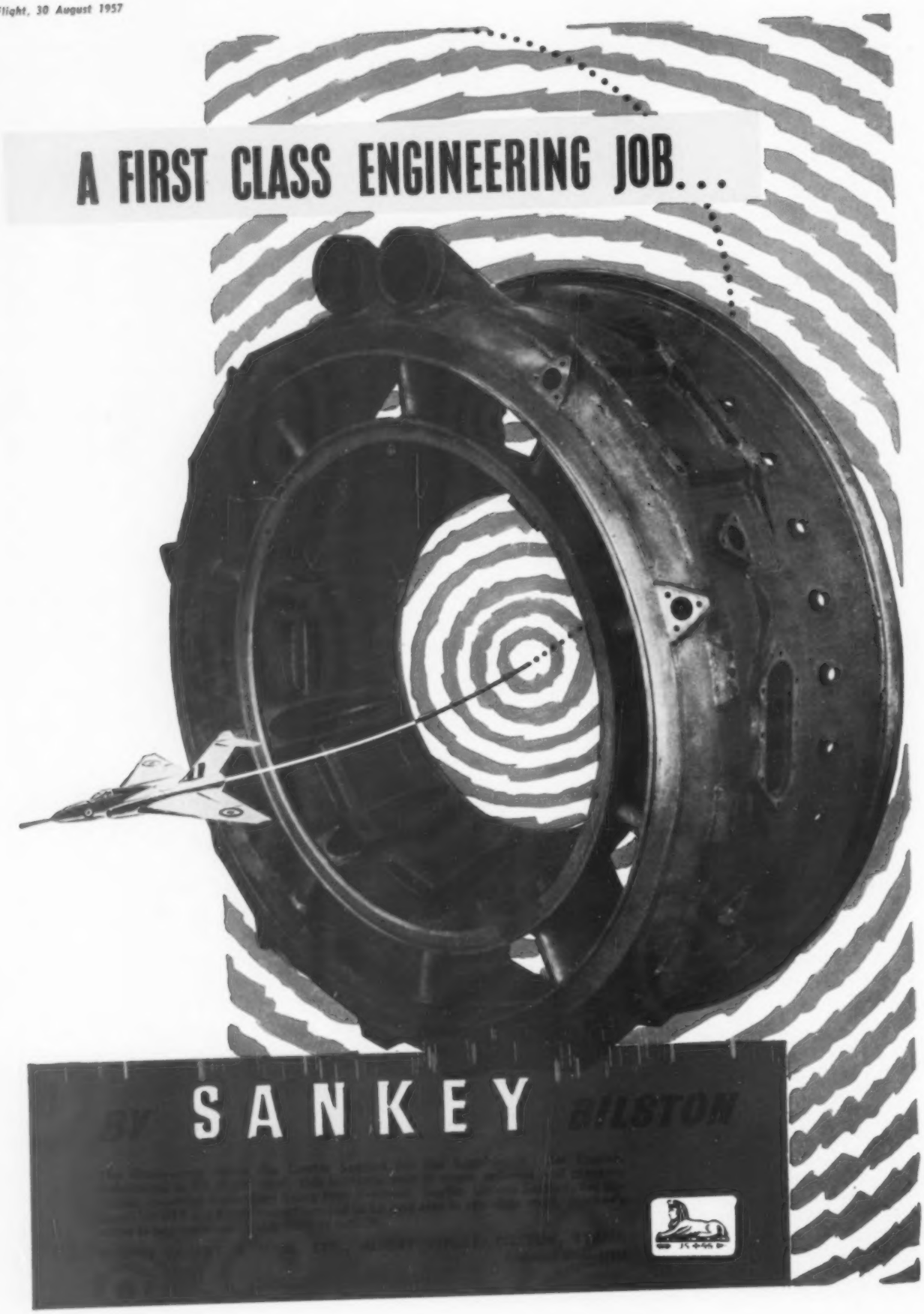

SANKEY

Overnight to Johannesburg

Only a few decades from now, great airliners like this will be flying at heights around 150,000 feet above tropical Africa on the overnight London–Johannesburg run.
On a clear moonless night passengers may see the shimmering reddish-yellow light of the Zodiacal Band stretching like a bridge across the heavens from west to east. According to Fessenkov, the phenomenon is connected with the scattering of light by meteoric matter in interplanetary space; but it also depends on terrestrial atmosphere, the upper layers of which on the night side of the earth are stretched into the characteristic long oval by light pressure.
The petroleum products required for flights at stratospheric altitudes and the extremes of temperature involved are already under active development by Esso Research.

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BRITISH AIRCRAFT 1957

SAILPLANES

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Albert Works, Newbury, Berks.
Telephone: Newbury 312.

UNDOUBTEDLY the most interesting aircraft at the recent National Gliding Championships at Lasham was the laminar-flow Olympia 403 built by Elliotts and flown into third place in League 1 by Cdr. G. A. J. Goodhart. This performance was a remarkable one for an aircraft completed only one day before the opening of the competition, and for a brand-new pilot/aircraft combination.

The Olympia 403 is the third in the Olympia 4 series, the 401 being the 15-metre machine which appeared at the 1954 World Championships and the 1955 Nationals; and the 402 the extended-wing version (span increased by 6ft) flown by Ivans at St. Yan in 1956. The new machine features an all-moving tail fitted with anti-balance tabs and (as a temporary measure) external mass-balance weights. The area of the fin and rudder has been increased.

The wing-section of the 403 is the same as that of the 402 with the exception of a slightly thickened root. The fuselage has been lengthened, redesigned under the wing and is no longer "necked." The cockpit canopy has been widened considerably.

Further development of the Olympia 403—and of the vee-tailed K.1, also owned by Elliotts—is continuing at the Royal Aircraft Establishment, Bedford. The 403 is clearly a sailplane in the world-championship class, but no plans for further production have yet been made.

Elliotts Olympia 403.

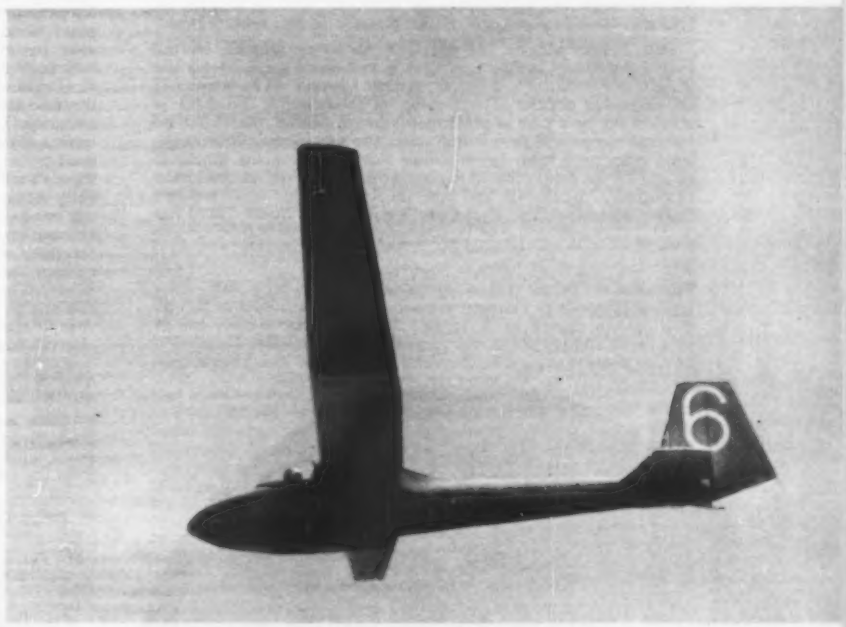
SLINGSBY SAILPLANES

Kirbymoorside, Yorkshire.
Telephone: Kirbymoorside 312.

NO FEWER than 24 Slingsby Skylark variants appeared at this year's National contests, of which one was the prototype Mk 1, 14 were Mk 2s and nine Mk 3s. The straight, functional lines of these aircraft have become a familiar sight in British gliding—and, indeed, in world gliding, as Slingsby's impressive record in the export field has shown. The Dutch national champion this year was chosen on the results of a one-type contest at Terlet Gliding Centre—and that one type was the British Skylark 2.

Both Mk 2 and Mk 3 Skylarks are in production at Kirbymoorside. The 48ft span Mk 2 has a gliding angle of 1 in 30 at 49 m.p.h. while the 60ft span Mk 3—with the exceptional aspect ratio of 20.5—gives an angle of 1 in 36 at 47 m.p.h. Both versions feature a three-piece laminar-flow wing, as does the Slingsby T.42B Eagle advanced two-seater.

A new development now well under way at Kirbymoorside is the construction of the first T.45 single-seater, in effect a "poor man's Skylark" with a span of 40ft. This prototype, which is expected to fly by the end of September, has been designed in an attempt to combine simplicity and economy with high performance. For the future, it is highly probable that the Skylark 2 will be chosen as Britain's entry for the "limited class" in next year's world championships.



Slingsby Skylark 3 (above) and T.42B Eagle.

BRITISH MISSILES 1957

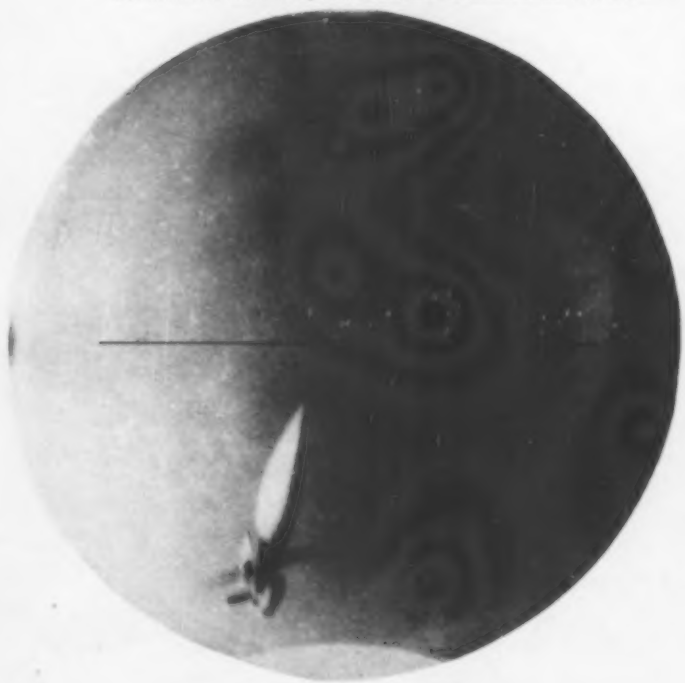
AT the end of World War 2 the chiefs of the British armed services and their civilian counterparts in the Ministry of Supply and the Air Ministry, War Office and Admiralty began long and earnest discussions with a view to the formulation of plans for Britain's future weapons. As is now well known, it was considered that our national economy would not support the development of a multitude of complex families of weapons similar to those projected in the U.S.A. Instead, it was argued, calculated risks would have to be taken, and whole generations of weapons ignored.

The first major programme was reckoned to fill the period 1947-1957, during which time it was hoped that no major war would occur. This ten-year development has given us the Victor and Vulcan and the first generation of British guided weapons. The latter are shortly to enter operational service, not much later than the date originally programmed nearly a decade earlier.

Fairey

One British missile, the Fireflash air-to-air weapon by the Fairey Aviation Company, is already in limited service with the R.A.F. as a training and indoctrination weapon. The subject of an extensive article in our issue of August 16, Fireflash is accelerated by a pair of jettisonable boost motors, but it has no internal motor and thus is not subject to one of the major problems associated with beam-riding missiles (irregular guidance caused by the ionization in the rocket flame). Fireflash has been extensively developed and can be carried by most modern fighter aircraft. The long-span Supermarine Swift Mk 7 has been specially evolved to carry up to four of these weapons, and this aircraft equips a special development squadron.

***Bloodhound**, by the Bristol Aeroplane Company with semi-active homing guidance by Ferranti, presents a fearsome aspect in the eye of a camera carried by its target. The twin Thor ramjets can be seen above and below the rear fuselage. This particular Bloodhound was not fitted with an explosive warhead. Note the camera graticule*



de Havilland Propellers

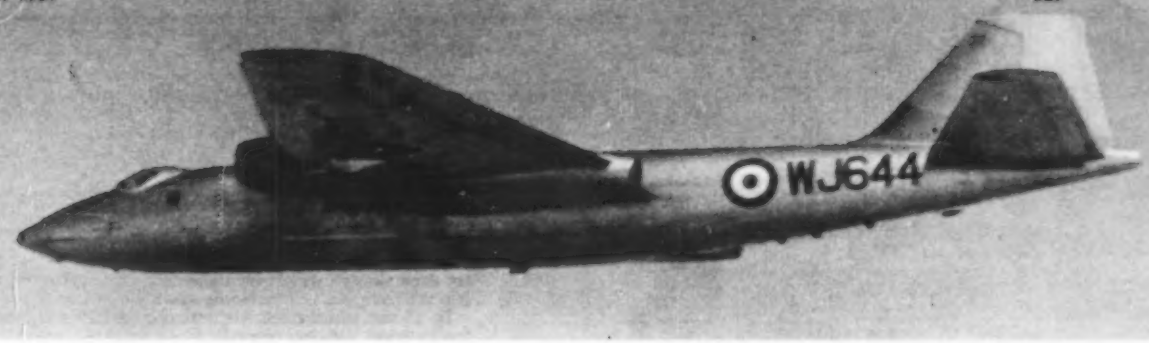
Hard on the heels of Fireflash is the appreciably larger—and one may therefore conclude, more effective—Firestreak developed by de Havilland Propellers. Firestreak is equipped with a single solid-propellant motor, probably situated ahead of the heavy ring carrying the control surfaces and connected to the propelling nozzle by a tubular duct. This motor gives exceedingly high thrust for a relatively short burning time.

Firestreak is more than ten feet in length and has considerable body-volume for the heavy warhead and the guidance, control and propulsion systems. Like the latest American air-to-air weapons Firestreak has infra-red guidance, which means that it tends to "home" on to sources of heat at a particular pre-selected temperature—such as the hot metal parts of the turbojet powerplants of an enemy bomber. A photograph taken during a recent visit by Her Majesty the Queen to the R.A.F. Station at Leuchars revealed that the nose of Firestreak is of octagonal section, being formed from eight flat triangular panels. Clearly the flat panels must be as transparent as possible to infra-red radiation of the agreed wavelength, and the Firestreak nose minimizes distortion and thus allows the scanner in the homing head to "see" the target as clearly as possible. The design problems attendant upon the manufacture of such a nose must have been immense. Even with very slight angles of attack or yaw the air-loads on the nose of a high-supersonic weapon can become enormous, and the material chosen must also withstand extremes of temperature and erosion, particularly when flying through rain or hail. Firestreak's nose not only passes the weak infra-red rays from the target with minimum distortion but it also stands up to all service conditions in an admirable fashion.

It is also worth noting that Firestreak cannot see its target clearly when the nose is allowed to ice-over, and so considerable quantities of hot air have to be fed to the weapon to de-ice the nose before launching. Cold air is also probably required to cool the various electronic "black boxes" and special electrical supplies are certain to be required during the pre-launching phase to prevent drainage of the weapon's own electrical capacity. These services would, of course, have been incorporated from the start on any aircraft designed to carry Firestreaks. For conversion purposes, a neat streamlined container has been prepared to house self-contained units capable of fulfilling all these functions and this container can be readily attached beneath a suitably converted fighter without disturbing the internal equipment of the aircraft in any way. Such a container could be seen beneath the Avon-Sabre shown launching Firestreak in a photograph on p. 70 of our issue of July 19, 1957.

The large heading photograph of the Firestreak and Canberra is remarkable in that it was taken with a still camera and is not a frame from ciné film. The Canberra is one of the hacks used by de Havilland Propellers at Hatfield for missile development (similar aircraft are visible on page 248 of our issue of March 2, 1956). Firestreak is carried on racks under the wings, the weapon itself having a very elegant mounting comprising four diminutive feet which pick up in jettisonable shoes capable of attachment to a standard stores pylon. The Canberra is seen to have a pointed nose embodying some form of radar or photographic gear. Pencil-beam radar is unlikely, since it is almost certain that Firestreak's homing head is locked on to its target before firing. One may conclude, therefore, that the Canberra nose carries telemetering or camera equipment, since full A.I. radar would be far larger.

Most important immediate application of Firestreak is the Gloster Javelin all-weather fighter. It has just been revealed that production Javelins will carry four of the big de Havilland weapons, and a Javelin FAW.7 is expected to fly at next week's



Firestreak, the standard air-to-air weapon of the R.A.F. and Royal Navy, leaves a Canberra during development trials by de Havilland Propellers.

S.B.A.C. Show with four Firestreaks under its broad wings. The weapon is likely to go into squadron service next year and should enormously enhance the killing power of Fighter Command. Compared with corresponding American weapons Firestreak is larger and has wings of very much greater area. It can be concluded, therefore, that it carries a particularly effective warhead, and its lower wing loading (compared with such weapons as Sparrow or Sidewinder) should allow the British weapon to pull nearly twice as many "g" and make it quite impossible for any aircraft to avoid being intercepted when once the Firestreak has locked-on.

Vickers-Armstrongs

According to a recent announcement, Vickers-Armstrongs (Aircraft) are likely to exhibit at the forthcoming display an air-to-air weapon bearing the appellation "Red Dean" (presumably a code-name of the same *genre* as "Sea Slug"). Twelve months ago a daily newspaper commented upon the cancellation of contracts for a Vickers air-to-air weapon by describing the design as "too complicated"; in fact, the missile had been prepared to meet the needs of future supersonic all-weather fighters, such as the "thin-wing Olympus Javelin," and cancellation of this aircraft naturally resulted in elimination of the requirement for its weapon—or, at least, that is the official view. Vickers have acquired substantial experience with various guided-weapon programmes, and their exhibition of Red Dean apparently indicates their willingness to produce such weapons for export.

Bristol

The remainder of our first-generation weapons are anti-aircraft missiles designed for launching from surface sites or naval craft. Possibly the first such weapon to come into service will be the fearsome-looking Bloodhound developed by the Bristol Aeroplane Company, with guidance by Ferranti and propulsion by Bristol Aero-Engines. Now in production for the R.A.F. as the standard anti-aircraft missile for home-defence Bloodhound is an extraordinarily interesting weapon with a number of exceptionally fine qualities.

Its long and slender fuselage houses a mighty warhead and semi-active guidance system, the extreme nose—apparently of ogive form—obviously having to accommodate a dish-type scanner and receiver for the radiation reflected from the target. Further aft the main bulk of the body must be occupied by kerosine tanks, the fuel being fed by air-turbine-driven pumps (similar to those exhibited at the 1956 S.B.A.C. Show and illustrated on page 490 of our issue of September 14 last) to the twin ramjets—presumably of the Thor type—which are mounted above and below the rear fuselage. Thor has a diameter of 16in and is one of the most highly developed high-supersonic air-breathing engines in the world, with a Mach capability which probably approaches 3. Starting and light-up reliability is now virtually perfect and the fuel system of Thor has been described as better than that of any other ramjet. For launching purposes Bloodhound is fired by four wrap-round motors, strontium flares being used to ignite the main engines.

Unlike all other contemporary British missiles Bloodhound does not have a cruciform wing, but flies like an aeroplane with a single lifting surface in the horizontal position. It therefore manœuvres by roll-and-steer (unless it has been found possible to generate sufficient lift from the nacelles of the ramjets to provide adequate lateral acceleration), the horizontal tail controls acting as elevators and ailerons. The guidance system is of the semi-active homing type in which a ground radar illuminates the target while the missile homes on to the reflected radiation. At present an H.E. warhead is used, but it has been officially stated that in future versions of the weapon a nuclear warhead will be employed. Throughout the design of the whole weapon-system great efforts have been made to improve simplicity and reliability, and to allow the weapon to fit into any kind of defence environment irrespective of the control and reporting system which might already be in use.

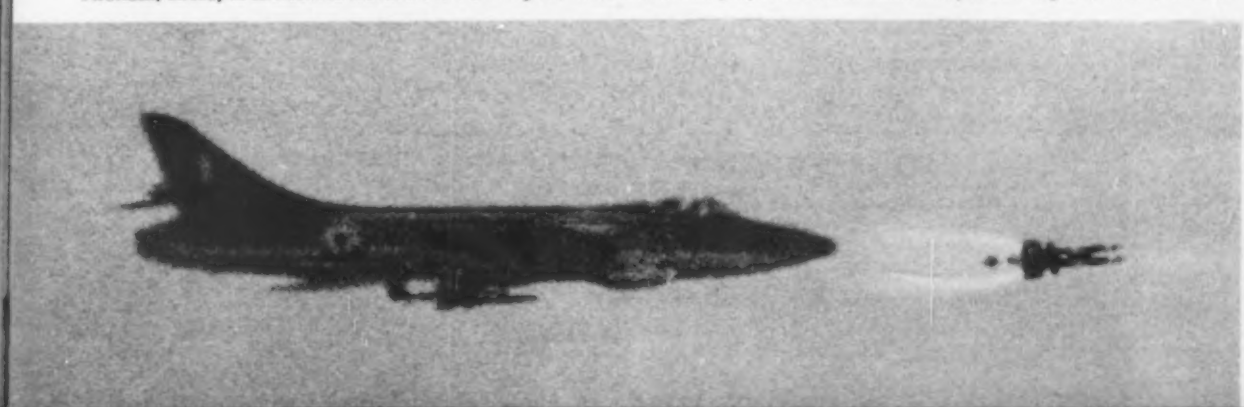
English Electric

A counterpart to Bloodhound is the Thunderbird anti-aircraft weapon developed by the English Electric Group. Thunderbird has been developed through several phases and has emerged as an effective and attractive weapon-system which is already in bulk production for the British Army and the R.A.F. for use in all parts of the world.

Of classic "British" configuration, Thunderbird has a cruciform of wings and control surfaces, indexed at 45-deg to each other, mounted on a cylindrical fuselage with a conical nose and a boat-type tail, the whole assembly being boosted by four large wrap-round motors mounted around the rear part of the body. The sustainer motor is a rocket, both liquid-propellant and solid versions being in use.

Thunderbird is already well known and has several times been described in our pages. At the recent Paris Salon a working model showed an early version of the Thunderbird system, involving an underground store in which single rounds could be mounted on a large launcher running on a short length of railed track. The launching ramp itself was hydraulically powered in elevation up to 90 deg, and a turn-table was built into the end of the track to provide azimuth variation. Such an arrangement has now been superseded by more mobile systems not dependent on a fixed ground installation. Every part of Thunderbird has been specially developed for arduous service in difficult climates and it has already been found exceedingly

Fireflash, already in service with the R.A.F. as a training and indoctrination weapon, is seen below immediately after being fired from a Hunter.



Thunderbird by the English Electric Group—including Napier propulsion and Marconi guidance—is to be built in large numbers for both the R.A.F. and the British Army. It is shown in the boost phase.

well suited to actual operations with crews drawn solely from serving personnel.

Armstrong Whitworth

A particularly informative illustration at the foot of the page depicts a test round for the Sea Slug anti-aircraft missile, which has for many years been developed by Armstrong Whitworth Aircraft at Whitley, near Coventry. From the outset this weapon has been associated with the Royal Navy.

The large cylindrical body has a conical nose of about 20 deg included angle and maintains its full diameter of about 16in right to the tail. Construction is monocoque and the body appears to be fabricated from wrapped and welded sheet joined at strong rings. In the Sea Slug illustrated a liquid-propellant motor is used (presumably of Armstrong Whitworth design and manufacture). Fuel and oxidant are fed by large free-pistons, occupying the whole diameter of the body, which are pushed out by gas pressure (probably from a cold cordite charge), each piston moving outwards from the c.g. of the missile to prevent the latter from moving axially as the propellants are consumed. Between the tanks is a major body-joint with about 20 skew bolts.

The rectangular wing is not solid but is fabricated from spars and chordwise members apparently rubber-pressed from sheet. The layout of spars clearly transmits the load to a single band in line with a strong body ring which carries all four wings. Although it would be an advantage for shipboard stowage to have detachable wings, it is likely that the Sea Slug is assembled and rigged as a ready-to-fire weapon before delivery. The spars seem to be continuous through the chordwise members and each wing is completed by riveted doubler plates (as shown in the picture) together with an extruded section around the periphery and heavy-gauge skins forming the complete parallel double wedge profile. Each control surface is also of rectangular form and seems to be a similar fabricated structure. It differs, however, in having what seems to be a steel tongue to which the air loads are diffused by raked spars and riblets, the tongue finally transmitting all loads to the forged steel actuating shaft. The control surfaces are indexed in line with the wings.

In a production Sea Slug the conical nose would presumably house a homing radar head with a dish scanner. Farther aft one would expect to find the fusing and the warhead, but in a test round such as that illustrated telemetering equipment is more likely; the photograph shows multiple stub aerials projecting from the body. At the rear end, aft of the tankage, are the guidance and control units, the former being the responsibility of G.E.C. and Sperry being the sub-contractors for the electro-hydraulic servos. Near the tail is the large control-ring casting, through the centre of which is mounted the single-chamber motor. It is believed that later Sea Slugs have a large solid-propellant motor—possibly using an extruded charge similar to that exhibited by I.C.I. at the 1956 S.B.A.C. Show.

Most of the Sea Slugs so far seen have had four triple boost units (a total of twelve motors in all) and these have been mounted around the fore body and thus do not require stabilizing fins. The rear attachments for the boost motors are disposed around the mid-section of the body and at the front are axial slots in which are located the spectacle casings which join the front ends of the boost motors.

In all the installations yet revealed Sea Slug has been fired from a triple launcher controlled by special lock-on ship's radar. Successful service trials have been carried out for a considerable period with H.M.S. *Girdle Ness* and Sea Slug is expected to form the main armament of guided-weapon destroyers for which contracts have been placed.

The six weapons already referred to complete the first generation of Britain's guided weapons. It is, however, known that later types of missile are at present in active development and, although we may scarcely expect to see these devices contributing to our effective strength for several years to come mention should be made of two programmes which have already been officially commented upon.

Stand-off Bomb

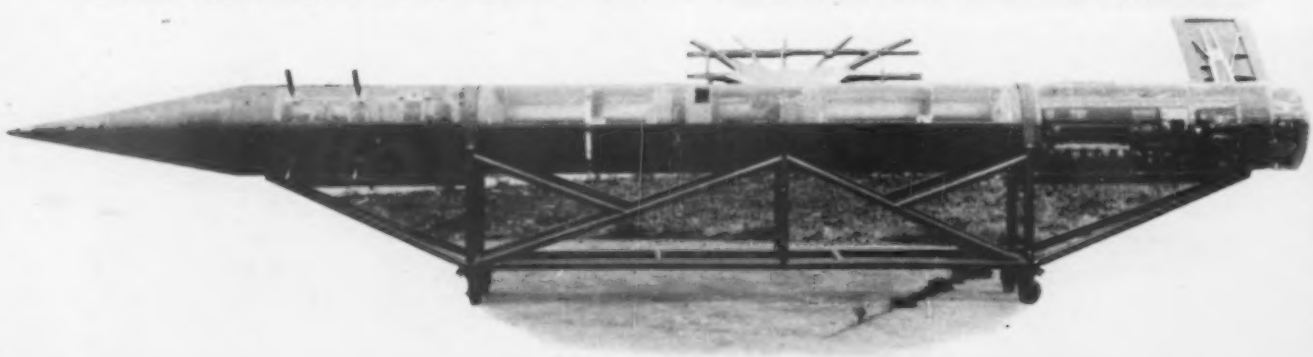
Earlier this year it was stated that work was in hand upon an air-to-surface weapon of the type known in Britain as a stand-off bomb; such a missile is carried by a manned bomber to within "several hundred" miles of the target and is then launched and allowed to proceed to its destination while under a self-contained guidance system, while the parent aircraft returns to its base with all possible speed. One might expect such a device to be a winged cruise-type vehicle of aircraft configuration, weighing at least 10,000 lb and driven by rocket motors, or possibly ramjets, at a speed at least twice that of sound. Sir Roy Dobson, chairman of Avro, is reported to have said in Australia that his company is one of those primarily concerned with this programme.

IRBM

Finally, it has officially been stated that several British companies are at work on one or more designs of ballistic bombardment missile. It is exceedingly unlikely that any attention is being paid to weapons in the intercontinental class (4,000 to 5,000 miles surface range) and it may be supposed that our first ballistic weapons will have a range of 1,500 to 2,000 miles. In view of the fact that Britain is to receive similar weapons from the U.S.A. one must conclude that our own programme is being pursued either in order to acquaint our design teams with this enormous and challenging field or in order to provide us with a weapon superior to the American Thor or Jupiter. No mention has been made of any British ballistic weapon for shipboard use comparable to the U.S. Navy's Polaris.

Unofficial reports have named English Electric and de Havilland Propellers as major contractors in the development of British ballistic weapons. In view of the present climate of defence spending in the United Kingdom, it is most unlikely that we can support two separate programmes of such a magnitude as that required to produce an operational 2,000-mile-range weapon, and it may be that all those at present engaged in this work are collaborating upon a single design. One of the few deductions which can be made with assurance is that the prime contractor for propulsion will be Rolls-Royce, who hold a licence from North American Aviation in respect of large rocket motors and who manage the Ministry of Supply test station now being constructed at Spadeadam, near Carlisle.

Sea Slug is the code name for the Armstrong Whitworth/G.E.C./Sperry anti-aircraft weapon for the Royal Navy. This special display exhibit is described as "a scaled model of an early type of unguided development round" cut open to reveal the structure and the liquid-propellant feed.



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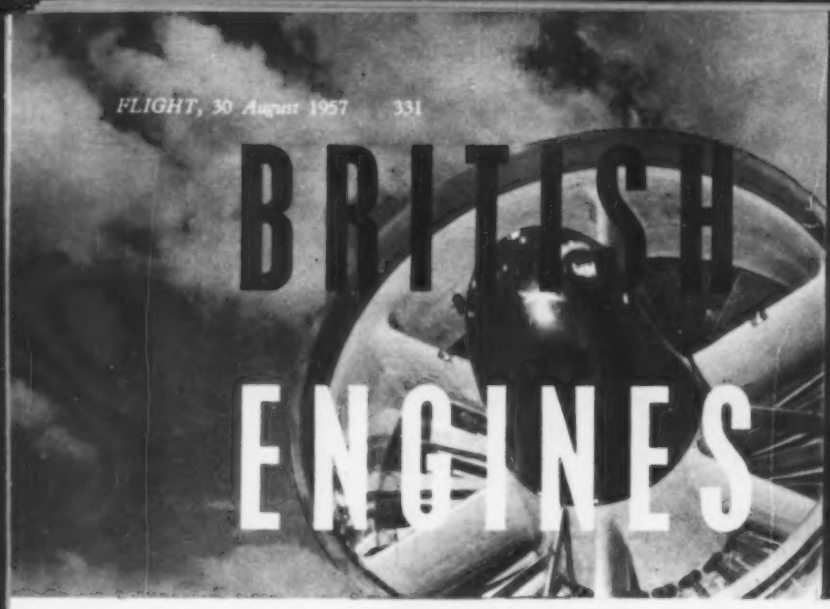
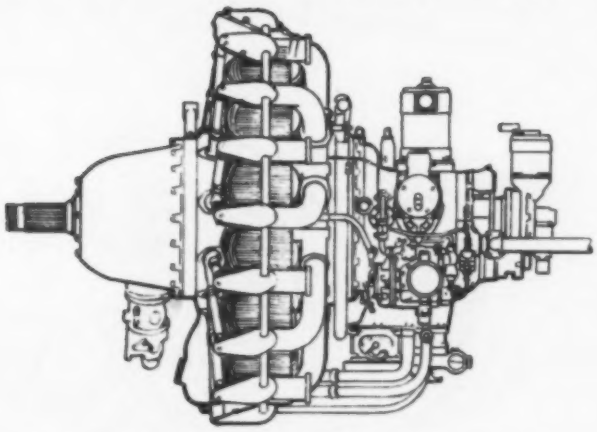
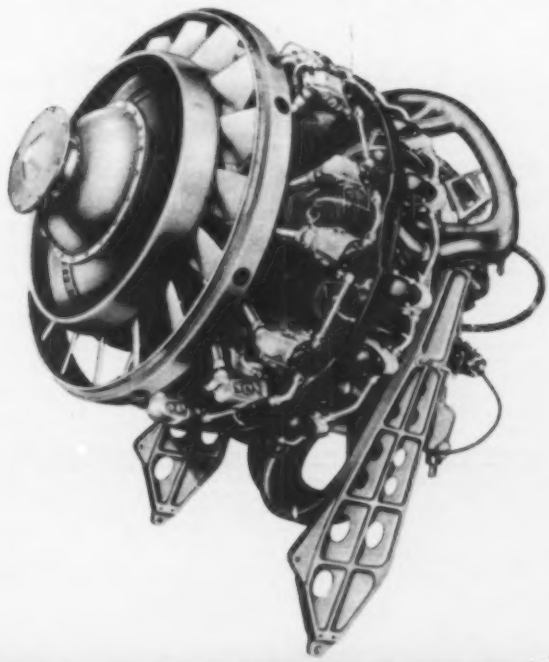


BRITISH AERO ENGINES 1957



Alvis Leonides 503/8. Piston engine for fixed-wing aircraft. Nine-cylinder, poppet-valve, supercharged and geared radial engine with injection-type carburettor. Overall diameter, 41.5in; length, 54.4in; bore, 4.8in; stroke, 4.41in; swept volume, 718.6 cu in; dry weight, 810 lb; maximum rating, 520/540 h.p. at 3,000 r.p.m. with boost of 8 lb/sq in.

Alvis Leonides Major 155. Helicopter engine. Two-row 14-cylinder piston engine mounted in the Whirlwind at 35 deg with supercharger and direct drive with cooling fan. Overall diameter, 38.9in (basic engine); length as shown, 54.86in; bore, 4.8in; stroke, 4.41in; swept volume, 1,118 cu in; dry weight, 1,050 lb; one-hour rating, 780 h.p. at 4,250ft at 2,900 r.p.m. with 6¼ lb/sq in boost; weak-mixture rating, 585 h.p. at 11,000ft at 2,800 r.p.m. with ¼ lb/sq in boost.



ALVIS, LTD

Coventry
Telephone: Coventry 5501

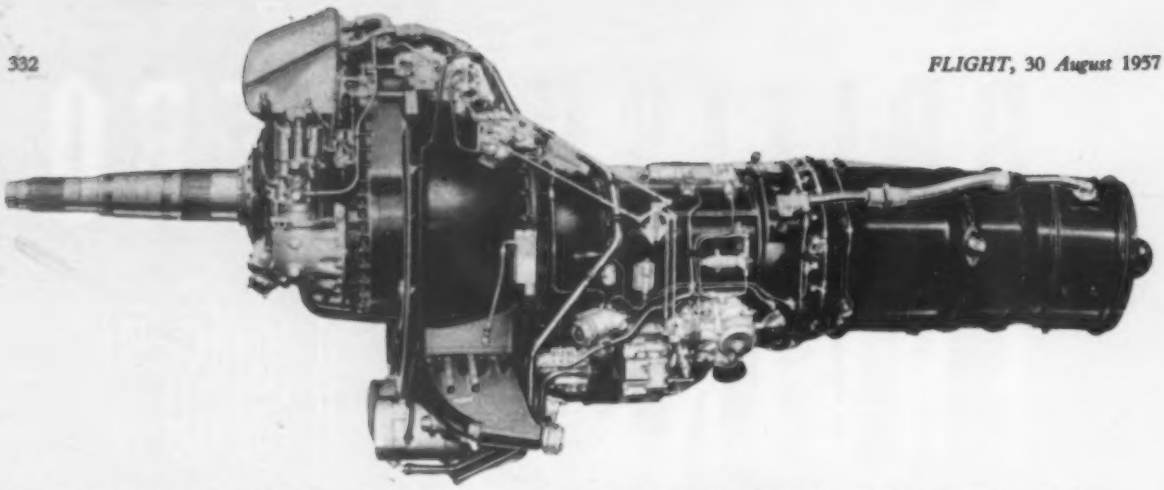
Leonides The fixed-wing types of Leonides have already flown well over 1,000,000 hr with the R.A.F. and remain in quantity production for numerous air forces and civilian operators in every part of the world. Typical of the substantial contracts which have been received during the past year are those placed by the Federal German Government for 33 Hunting Percival Presidents and no fewer than 50 Bristol Sycamore helicopters, both of these types being Leonides-powered. Several hundred engines are in daily service with the R.A.F. Flying Training Command as the powerplants of the Hunting Percival Provost and there are numerous other current or projected applications.

Leonides Major Although it uses a virtually identical design of cylinder/piston assembly, the basic Major is a slightly slimmer unit than the single-row engine owing to the fact that only seven cylinders need be accommodated in each row. Like the earlier engine the Major is a supercharged unit with an injection-type carburettor and it is equipped with every type of accessory which an installation could require. Typical of the fixed-wing applications is the Handley Page Herald transport, the powerplants of which are rated at 875 b.h.p. at 3,000 r.p.m. with 9½ lb/sq in boost. These engines are installed in a very neat petal-cowled powerplant and drive a three-blade reversible D.H. Propeller. An accompanying photograph depicts the Major 155, which is now in production as the powerplant of the Westland Whirlwind H.A.R.5 and H.A.S.7 helicopters. A similar engine is the Major 151 which is installed vertically in the first version of the Bristol 192 tandem-rotor, twin-engined helicopter. In order to provide this aircraft with maximum single-engine performance the one-hour rating of the Major 151 is no less than 860 h.p. at 2,900 r.p.m.

ARMSTRONG SIDDELEY MOTORS, LTD

Parkside, Coventry
Telephone: Coventry 62666

Sapphire Production Sapphires have been of two main categories. The first-generation engines of the 100-series went into production in August 1953 and some thousands were delivered for use in Hunters and Javelins before production of this family of engines ceased late in 1956. The principal ratings of first-generation Sapphires are the ASSa.6 of 8,000 lb thrust and the ASSa.12 of 8,800 lb thrust; these engines are flying several hundred hours daily with the R.A.F. Fighter

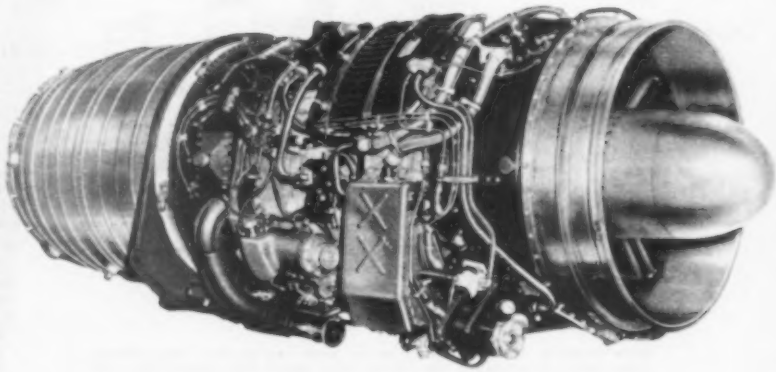


Armstrong Siddeley Double Mamba ASMD.8. Double turboprop. Two mechanically independent power sections, each driving one unit of twin co-axial propellers; each power section comprises a Mamba 8, with 11-stage compressor, annular vaporizing combustion chamber and three-stage turbine. Overall width, 56.55in; height, as shown, 45.28in; length, 109.7in; maximum rating, 1,800 s.h.p. plus 300 lb-thrust per side, a total of 3,850 e.h.p. All other data restricted. This engine is cleared to run on ship's diesel fuel.

Command and are setting admirable standards of reliability and are held in the highest esteem by their pilots.

A derivative of the Sapphire 100-series was at one time projected as a possible commercial-transport powerplant. Weighing less than 2,000 lb it would have had an exceedingly competitive performance and might have provided Armstrong Siddeley with an opening to the civil market. More than 10,000 military Sapphire 100-type engines have been manufactured in the U.S.A. under a licence agreement held by the Curtiss-Wright Corporation; the American engines are designated J65 and are operated by the U.S. Air Force, Navy and Marine Corps.

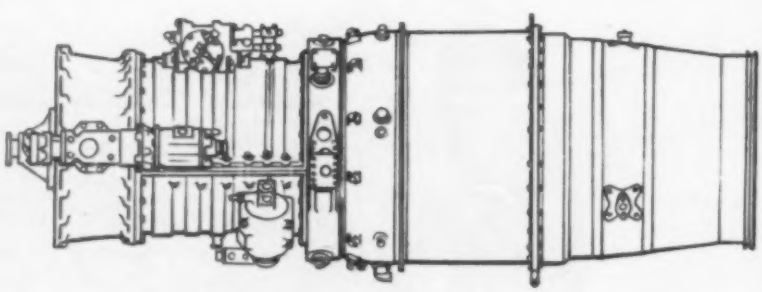
The photograph shows a production Sapphire ASSa.7 or 200-series engine of the type now in production at Brockworth for advanced R.A.F. aircraft (presumably the Victor and the Javelin). As a result of their very attractive design improvements these new engines deliver appreciably increased thrust than their predecessors, yet their specific fuel consumption is actually reduced and their life and reliability is in no way inferior. A revised jet-pipe with a two-piston nozzle is fitted to the "simplified type of reheat" Sapphire 7 which is being flown at the S.B.A.C. Show in a Gloster Javelin; the reheat Sapphire is expected to go into service next year, presumably fitted to late models of the Javelin.



Armstrong Siddeley Sapphire ASSa.7. Single-shaft turbojet. Thirteen-stage compressor, annular combustion chamber with 24 burners and two-stage turbine. Overall diameter, 37.4in; length as shown, 132in; dry weight (including anti-icing, turbo-starter, high-energy igniters and oil tank), 3,075 lb; maximum thrust, 11,000 lb at 8,600 r.p.m. with s.f.c. of 0.885. Other data on this engine are restricted. With a 12 per cent reheat jet-pipe this engine weighs 3,450 lb and has a rated thrust of 12,300 lb with s.f.c. of 1.2. The overall length of the unit is then 293in.

Viper During the past six years this small axial turbojet has developed from being a 1,650 lb-thrust short-life engine evolved from the Mamba turboprop to an entirely different type of unit resembling a scaled-down Sapphire with a conservative, long-life rating of 2,000 lb.

Early Vipers are widely used in Jindivik targets in Australia and Sweden and "long life" derivatives include the 1,750 lb-thrust ASV.8 which is the standard powerplant of the Jet Provost basic trainer and which is also used—with special downward-deflecting nozzles—in the Bell X-14 VTOL prototype of the U.S. Air Force. The ASV.8 has also been selected for various light aircraft of Italian and Yugoslavian design. Depicted in the drawing is the larger ASV.10 which is giving excellent results during its bench trials and is likely to lead to a new family of larger Vipers giving thrusts up to at least 2,460 lb. Derivatives of the Viper are also being developed and manufactured by the French firm of Marcel Dassault.



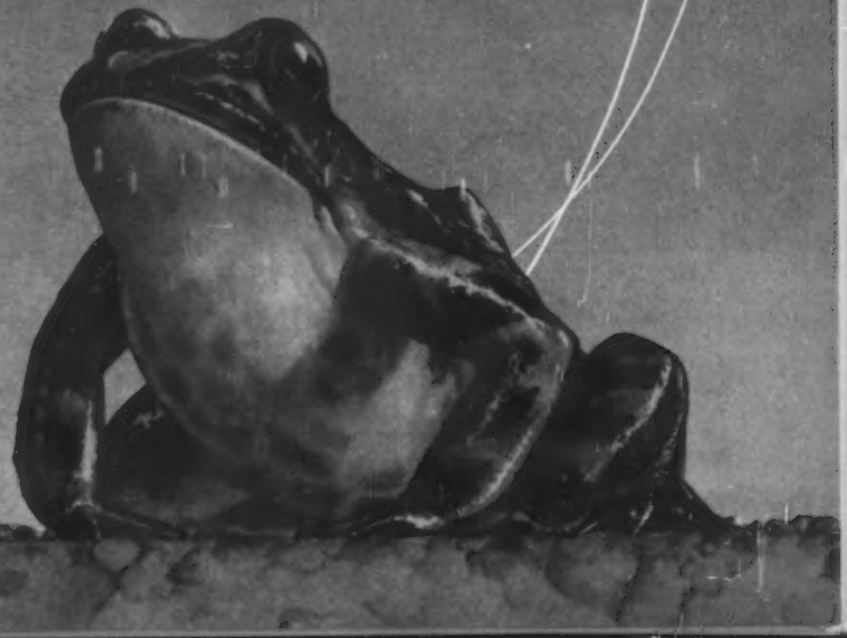
Armstrong Siddeley Viper ASV.10. Single-shaft turbojet with low top-temperature. Seven-stage compressor, annular combustion chamber with 12 vaporizing burners and single-stage turbine. Maximum diameter, 24.3in; overall length, 68.1in; mass flow, 42 lb/sec; pressure ratio, 4:1; dry weight, 570 lb; maximum thrust, 2,000 lb at 13,400 r.p.m. with s.f.c. of 1.01.

Double Mamba Several hundred ASMD.1 engines rated at 2,850 e.h.p. (1,270 s.h.p. per unit) are in service with the Royal Navy and the Royal Australian Navy as the powerplant of the Gannet A.S.1. In 1956 production switched to the ASMD.3 of 3,035 e.h.p. and the latest version is the more powerful and efficient ASMD.8 illustrated by the photograph. As in previous Double Mambas, both power sections of the ASMD.8 are mechanically independent, and each drives its own half of a co-axial double propeller, thus conferring upon the Gannet perfect single-engine behaviour. The engine operates upon ship's diesel oil and is fitted with a low-pressure pneumatic starter.

THE LEAPFROG

In the pursuit of air supremacy today, there is no "straight" line of scientific research. Rather, nations and their scientists play a deadly serious game of leapfrog in which, quite suddenly, unexpected advances in knowledge may place their possessor far ahead of his competitors. To this law of leapfrog, the development of guided missiles is no exception. And so, with the knowledge that here too freedom and liberty are dependent on our success at leapfrog, we in our Group are deeply involved in the perfection of this newest branch of aerial armaments.

This year at Farnborough you can see some of our latest achievements — civil and military aircraft, jet engines, and guided missiles — all designed and built by the Group that is proud to be a world leader in aviation.



RESEARCH
at Hawker Siddeley Group

Pioneer . . . and World Leader in Aviation

18 ST. JAMES'S SQUARE · LONDON · S.W.1

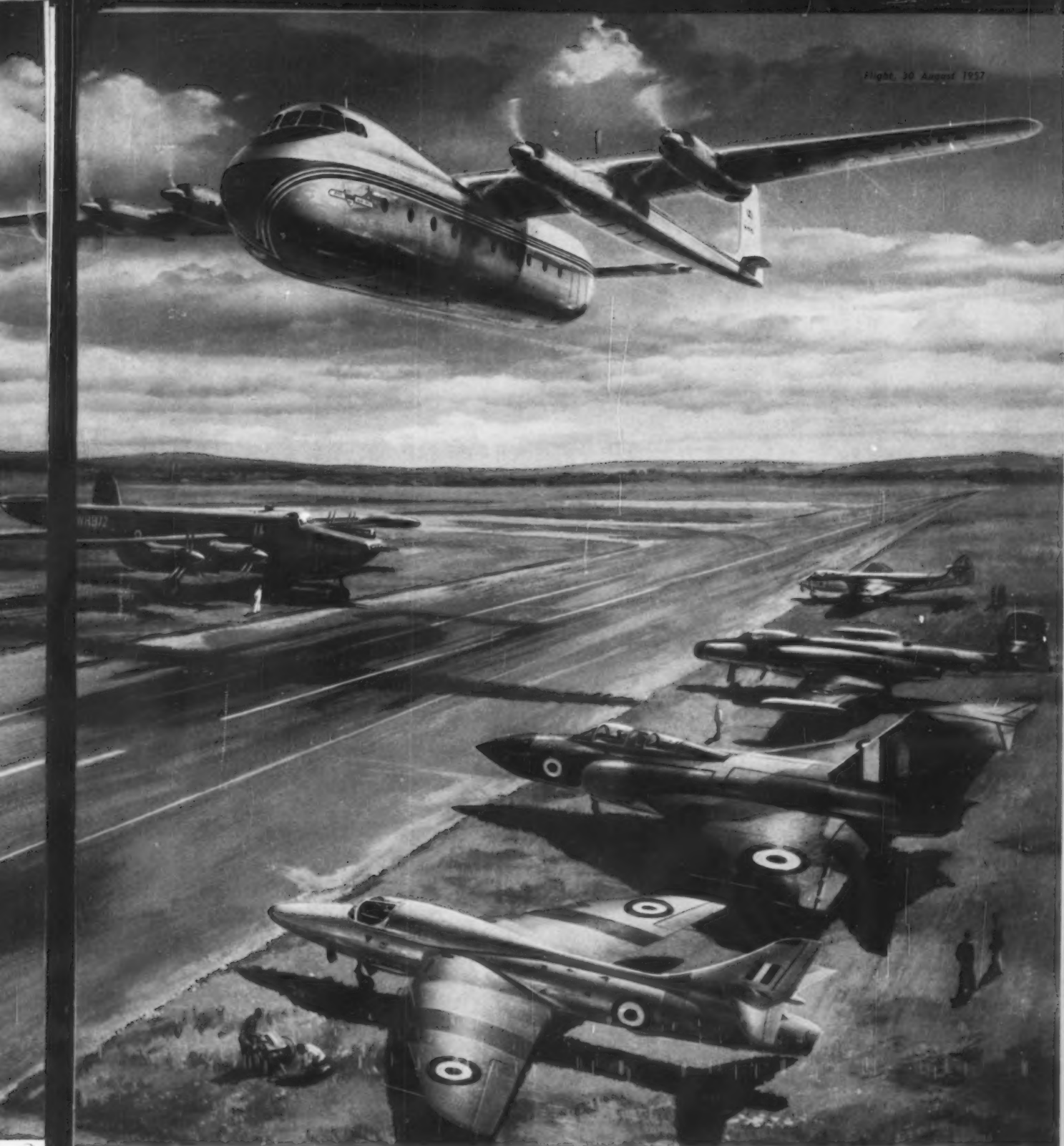
AIRCRAFT OF THE

HAWKER SIDDELEY GROUP

This panorama strikingly illustrates the variety of aircraft designed and built by the Hawker Siddeley Group. It symbolises diversity in defence, maritime security, high speed jet training, and civil air transport. It is a proud record of the Group's achievement.

Dominant in the sky, heralding the Future, is Hawker Siddeley's new civil venture, the AW 650. Designed and built by Armstrong Whitworth, it is the World's First Pressurised Turbo-prop Freightercoach. The prototype is due to fly at the end of next year ; already several operators have expressed interest in the aircraft.

The delta planform of the Avro Vulcan (extreme left, air and



ground) is being increasingly seen over Britain as the new V-bombers enter service with the R.A.F. The four-jet Vulcan is the latest in a famous line of Avro bombers, including the Avro 504 of the First World War and the illustrious Lancaster. Also from A. V. Roe comes the Shackleton (second left), in service with R.A.F. Coastal Command and the South African Air Force. These maritime aircraft range wide over the oceans, keeping radar eyes on vital sea lanes.

The Hunter two-seater (bottom right) is the latest version of Hawker's transonic fighter. It has been ordered by R.A.F. Training Command and is attracting increasing interest overseas. Hunters are also in service with the air forces of Sweden, Denmark, Holland, Belgium and Peru.

The Gloster Javelin (second right) combines with the Hunter to provide round-the-clock defence of Britain. The all-weather delta fighter is "well established and well liked" with the R.A.F., according to the Secretary of State for Air. From Canada comes Avro's CF-100 (third right), a long-range all-weather fighter in service with the R.C.A.F. and which has been ordered for the Belgian Air Force. Under development is the Avro Arrow Delta wing successor to the C.F.100, first Canadian aircraft ever to be ordered for a foreign air force. Last in this parade is the Sea Hawk, the Royal Navy's front-line carrier strike aircraft which will also be joining the Naval Air Arms of Holland and Germany.

A Sea Slug Test Missile being fired from H.M.S. Girdle Ness

HAWKER SIDDELEY GROUP PIONEER IN GUIDED MISSILES

The Hawker Siddeley Group's research and development teams that have helped to produce the foremost military aircraft are successfully coping with the new challenge of guided weapons.

A. V. Roe's Weapons Research Division is working to provide V-bombers with extra striking power with a guided air-to-surface weapon, known as a "stand off" bomb, which will increase the bombers' range by a considerable distance.

For Fleet protection at sea, Armstrong Whitworth Aircraft are developing a shipborne missile, the Seaslug. Successful firings of Seaslug have been made from the Navy's guided weapons trials ship, H.M.S. " Girdle Ness ".

ARMSTRONG SIDDELEY

Producers of the famous Sapphire, Viper and Double-Mamba gas turbine aero engines, this Company is currently developing a range of civil engines and doing much work connected with rocket propulsion. It has recently concluded a license agreement to manufacture AiResearch gas turbines and air turbine starters in Great Britain. The Sapphire engine is fitted to 14 of the world's most powerful military aircraft.

A Sapphire engine under inspection at Armstrong Siddeley (Brockworth) ▶

ORENDA ENGINES

The Orenda engine is currently in service, both in the CF-100 and the Canadair F 86, in Canada, France, Germany, South Africa and the Republic of Colombia. Orenda Engines are currently developing a new turbo-jet, the Iroquois, in which titanium is widely used. It is to power the RCAF's first supersonic interceptor, the Avro Arrow CF-105.

◀ *Removing an Orenda engine from the production test house*

AIR SERVICE TRAINING

Britain's " University of the Air " at Hamble is the only school of its kind in Europe where students can receive integrated ground and flying training *ab initio* to the standard required for a career in Civil Aviation. Pupils come from all over the world. A.S.T. facilities also include helicopter training.

The Aircraft Division of A.S.T. undertakes aircraft design work and the manufacture of aircraft components. They also specialise in the design and manufacture of aircraft toilets and toilet servicing equipment and quick-release caps and connectors.

British Aero Engines, 1957 . . .

P.181/182 In recent months Armstrong Siddeley Motors have been evolving a simple and rugged centrifugal turboshaft engine in the 1,000-h.p. class to meet a wide range of applications. A private venture, it is the company's first centrifugal unit and promises to be simple, cheap and reliable; and the size and ability of the company should ensure successful and rapid development. The following is an official statement which has now been authorized for publication.

"Two versions of a 1,000 shaft-horsepower engine are being developed on high priority by Armstrong Siddeley Motors, Ltd.; one version, at present designated the P.181, being for rotor-craft and the other, designated the P.182, for fixed-wing aircraft.

"These engines have been designed specifically for applications where reliability is of primary importance. The basic design is simple in concept and should result in rapid development to the stage where the engines will have long overhaul lives. Full use has been made of the extensive operating experience gained on the Sapphire, Viper, Mamba and Double Mamba engines so as to ensure the utmost reliability and ease of maintenance. Both versions of the engine have a large potential market and should prove attractive to many aircraft manufacturers and operators.

"Both the P.181 and P.182 employ the same compressor, combustion chamber and turbine assemblies, and they differ principally in the reduction gearing and final drives. The employment of a large number of common components will enable a considerable degree of parallel development to be undertaken, and accordingly will appreciably reduce the development time and cost."

Rocket Motors No information may be published on the work at present being carried out at the headquarters of the company's Rocket Division at Ansty, near Coventry. It is, however, clear that the pace of development is quickening and that the work is being carried out with high priority. An earlier (aircraft) motor, the Screamer, was fully described in our issue of July 27, 1956.

BLACKBURN AND GENERAL AIRCRAFT COMPANY, LTD. *Brough, East Yorks. Telephone: Brough 121.*

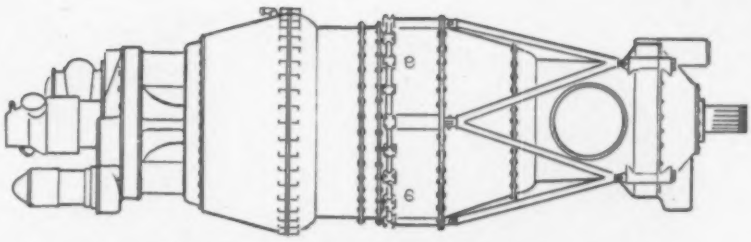
Palas A small turbojet, rated at 355 lb-thrust, the Palas is the progenitor of a wide range of small gas turbines which have been developed from original designs of the Société Turboméca, from whom Blackburn hold a manufacturing licence. The Palas has been manufactured in small numbers for use in such aircraft as the Somers Kendall S.K.1 and the Miles Sparrowjet; twin Palas are an alternative powerplant for the Miles Student.

Palouste A production batch of Palouste air-compressor units was manufactured for the Fairey Ultra-Light helicopter. As in the original French engine, the excess air delivery (which in the application mentioned is used to provide tip-jet propulsion for the rotor) is obtained by matching the gas turbine and combustion chamber with an over-size compressor.

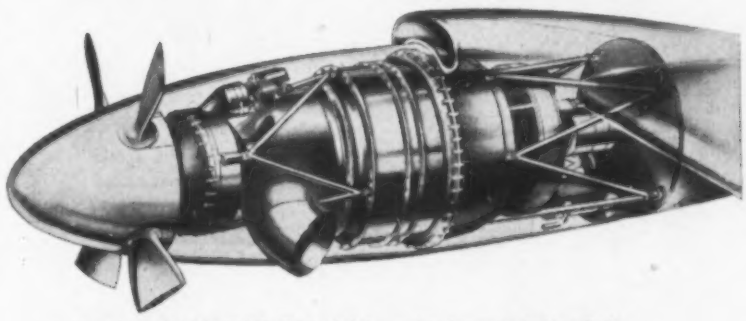
Blackburn hold a production contract for the supply of Palouste air-compressor trolleys for the Royal Navy. The air supply is delivered at about 40 lb/sq in through a flexible hose and used as a source of power for various aircraft services.

Turmo One of the most attractivé of the Blackburn-Turboméca engines, the Turmo has a free power-turbine and is suitable for applications in many fields. It is used in the American Kaman K-17 helicopter and has also been produced in coupled form with a single output-shaft capable of delivering 908 s.h.p.

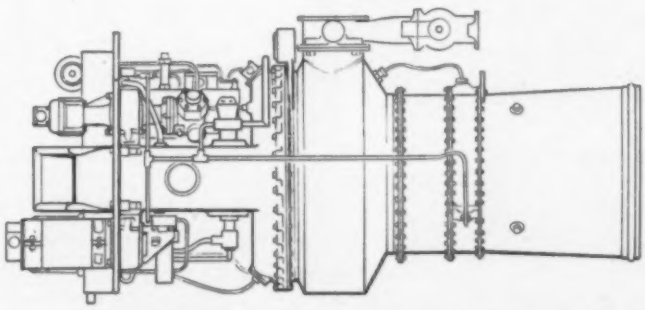
Artouste A single-shaft turbine, the Artouste can be equipped for installation as a turboprop. One version is in production as the prime mover of an airborne auxiliary powerplant which provides paralleled A.C. supply for a British bomber.



Armstrong Siddeley P.181. Free-turbine engine for rotary-wing aircraft. Two-stage centrifugal compressor, annular vaporizing combustion chamber, two-stage compressor turbine, single-stage mechanically independent power turbine, and reduction gear to output shaft. Overall diameter, 30in; length as shown, 85in; mass flow, 12.5 lb/sec; pressure ratio, not released; dry weight, 425 lb; maximum rating, 1,000 s.h.p. plus 200 lb residual thrust, with specific consumption of 0.74 lb/hr/s.h.p. or 0.687 lb/hr/e.h.p. Note: the P.182 fixed-wing turboprop is similar but is only 81in in length; the P.182 is illustrated immediately below.

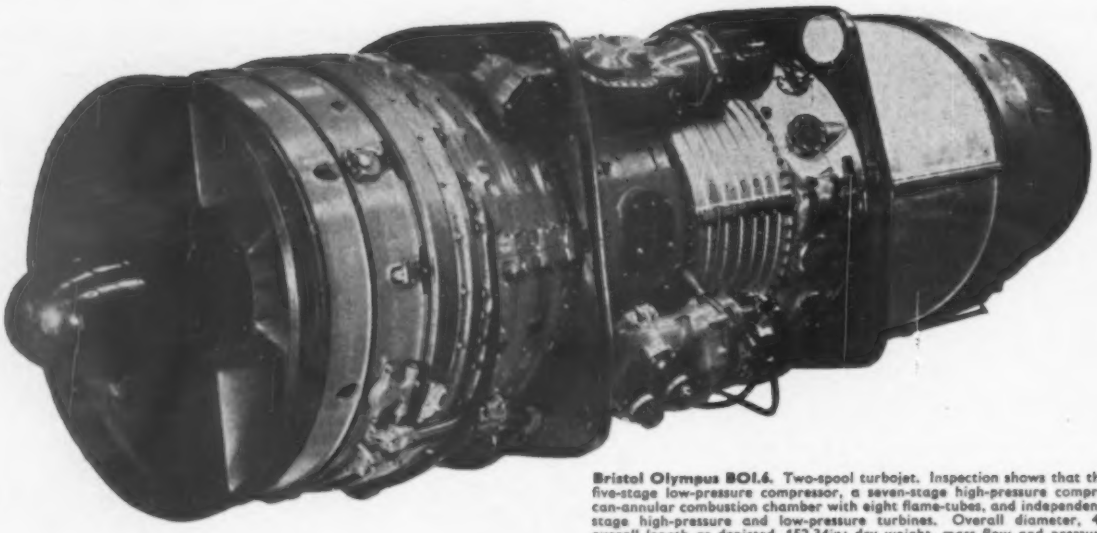


Armstrong Siddeley P.182. This artist's impression shows a typical installation, the intake being at the rear end. Data are given beneath the drawing of the P.181 above.

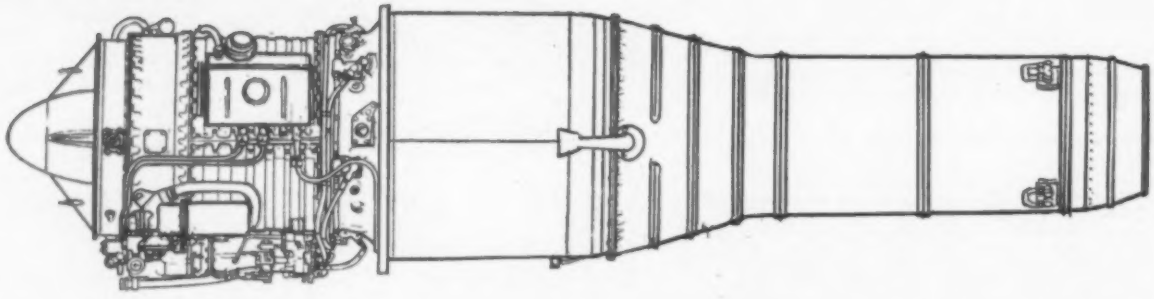


Blackburn Palouste. Air-compressing gas turbine. Single centrifugal compressor, annular combustion chamber with rotating fuel-injection nozzles, and single-stage turbine. Maximum diameter, 17.7in; height, about 18in; length, basic engine, 28.62in; dry weight, 178 lb; delivery 2.725 lb/sec air at 41.55 lb/sq in gauge, with fuel consumption of 310 lb/hr. This unit is fitted to the Fairey Ultra-Light.

Turmo. Free-turbine shaft-drive engine. Single, single-sided centrifugal compressor, annular combustion chamber with rotating fuel-injection nozzles, and single-stage turbine. Additional turbine stage added at rear end driving reduction gear to output coupling. Overall width, 17.1in; height, 21in; length, 46.12in; dry weight, with typical reduction-gear ratio, 281 lb; mass flow (Turmo 600), 7.19 lb/sec; pressure ratio, 4.12:1; maximum power, 450 b.h.p. at 36,000 r.p.m. with specific fuel consumption of 1.04 lb/hr/b.h.p.



Bristol Olympus BOl.6. Two-spool turbojet. Inspection shows that there is a five-stage low-pressure compressor, a seven-stage high-pressure compressor, a can-annular combustion chamber with eight flame-tubes, and independent single-stage high-pressure and low-pressure turbines. Overall diameter, 40.875in; overall length as depicted, 152.34in; dry weight, mass flow and pressure ratio, restricted (but see specification for the related Zephyr on p. 371); maximum thrust, 16,000 lb (r.p.m. and s.f.c. restricted). This engine will power the Vulcan B.2.



Bristol Orpheus BOr.3. Single-shaft turbojet. Reported to be seven-stage compressor, annular combustion chamber and single-stage turbine. Overall diameter, 32.4in; length as shown (with jet pipe), 150in; dry weight, about 750 lb; mass flow and pressure ratio, restricted; maximum thrust, 4,850 lb, reportedly with s.f.c. of 0.99. The Orpheus shown is equipped for the Fiat G91.

BRISTOL AERO-ENGINES, LTD.

Filton House, Bristol.
Telephone: Filton 3871.

Olympus One of the world's first two-spool, or split-compressor, gas turbines, the Olympus is an extremely efficient and highly developed engine. It was the first Bristol gas turbine to go into military service and it powers the Avro Vulcan medium bomber in all its production versions.

The first-generation Olympus 100-series was originally produced in 1954 at a dry rating of 11,000 lb (Olympus 101). Early in 1956 the series-102 engine succeeded it on the production line, the newer unit clearly having a zero-stage on the compressor and being rated at 12,000 lb. Current Vulcan B.1s are powered by the Olympus 104, in which comparatively minor improvements have permitted the dry rating to be raised to no less than 13,000 lb. Two series-104 engines are flying in one of the company's Canberra test-beds which will be flown at next week's S.B.A.C. Show.

A completely redesigned engine is the second-generation Olympus 200-series, formerly known by the development rating of BOl.6. The Olympus 200 is now in production at a rating of 16,000 lb dry for the Vulcan B.2. Compared with its predecessors the new Olympus actually has fewer compressor stages, from which one can deduce that the weight must be extremely competitive. The overall powerplant is beautifully neat and presents a very "clean" exterior. During its type-test an engine with an early type of blading reached corrected thrusts of 17,000 lb for one hour and 17,500 lb for 30 minutes, and appreciably higher thrusts have now been recorded.

Zephyr A joint development programme with the Wright Aeronautical Division of the American Curtiss-Wright Corporation has resulted in this extremely attractive commercial turbojet. Among the figures in its specification are the rated thrust of 12,500 lb with a turbine-entry temperature of only 1,000 deg K and a specific fuel consumption of 0.718. The engine can retain its thrust under adverse conditions of altitude and temperature without recourse to water injection, and it should be capable of rapid development for use in a variety of jet transports.

Orpheus A medium-thrust turbojet rated at from 4,000 to 8,000 lb according to sub-type, the Orpheus has been developed very rapidly and successfully since 1953. Originally a private venture, it is now officially sponsored and has important applications in aircraft designed by Britain, France, Italy, Yugoslavia, Japan, Spain and the U.S.A. For the latter market it is marketed as the Wright TJ-37.

For the Folland Gnat Bristol have evolved the BOr.2 of 4,520 lb dry thrust; this engine will be licence-produced at Bangalore for the Gnats of the Indian Air Force. The most important current-production engine is the BOr.3, illustrated; its thrust/weight ratio of 6 : 1 is probably the highest for any type-tested engine. The BOr.3 is at present flying in the Bréguet 1001 Taon, the Dassault Etendard VI and the Fiat G91, and a

licence-agreement for a similar engine was signed with the French S.N.E.C.M.A. company in February. Slightly different types of Orpheus have been developed for trainer and transport applications such as the Lockheed CL-329 (due to fly very soon) and the North American Model 246. Later versions of the engine give considerably increased thrust; the BOr.12 has a dry rating of 6,810 lb, which can be raised to nearly 8,000 lb with a simple form of afterburning.

Proteus This famous engine has for seven months been the only large gas turbine in scheduled commercial service in the Western world; it is also the most economical gas turbine in operational use (from the viewpoint of specific consumption) and it has shown itself to be an exceedingly reliable and well-engineered engine.

B.O.A.C.'s 15 Britannia 102 aircraft use the Proteus 705, rated at 3,900 h.p. These aircraft operate to Johannesburg and Sydney and will soon be flown into Tokyo; it is common practice for the complete round-trip, of perhaps 22,000 miles, to be flown without once opening the engine cowlings. Overhaul-life was 500 hr when scheduled service began on February 1, and it has now risen to 850 hr with a background of more than 100,000 hr of bench and flight operation.

All other Britannias at present being built have the Series 755 engine of 4,120 e.h.p. More powerful than the 705, and differing in several respects, the 755 has recently been subjected to a re-appraisal which has resulted in both increased cruising power and slightly reduced specific consumption. Among the minor changes which have been made are an alteration to the inlet guide-vane angle, polishing of the compressor blading and a change to a propeller with solid light-alloy blades.

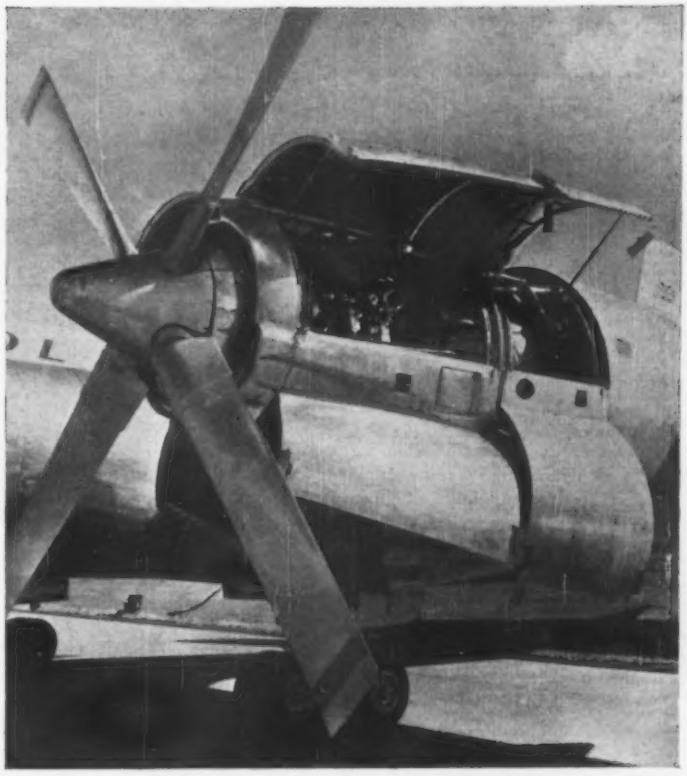
Orion Although similar to the Proteus in size and weight (the installed weight of the Orion is actually less) the new engine is even more economical and gives a cruising power some 65 per cent greater. The design-point was a cruise power of 3,500 h.p. at 30,000ft with a specific consumption "at least as good as that of the most economical piston engine." A unique feature of the Orion is that below about 20,000ft the fuel-flow is restricted to maintain the output at 4,400 shaft horsepower. Among the manifold advantages of this design-choice may be listed retention of the Proteus double-helical reduction gear and a similar size of propeller and the ability of the engine to give its full maximum power under all conditions of airfield altitude and temperature.

At the forthcoming S.B.A.C. Show an Orion will be displayed statically for the first time, and will also be flown in the No. 1 position on the first prototype Britannia. This aircraft is engaged in an intensive development programme, and four Orions are also to be fitted to the Britannia 301. Engines to production standard will be running at the end of the year and production deliveries will be made in about 18 months' time for the Canadair CL-44 transport. The Orion is also, of course, suitable for advanced versions of the Britannia and certain other aircraft.

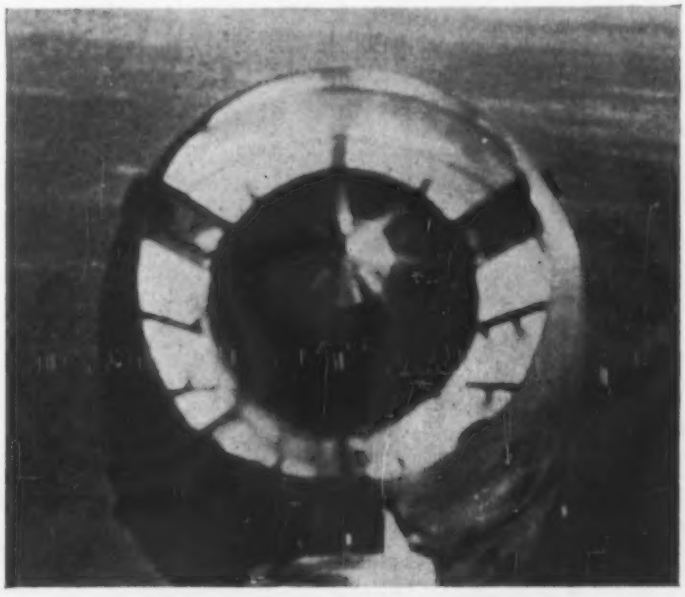
Piston Engines The Centaurus 18-cylinder unit of almost 3,000 h.p. is still in production for the Blackburn Beverley heavy military transport. More widely used is the 14-cylinder Hercules of 2,000 h.p., which is in large-scale licence-production by S.N.E.C.M.A. in France.

Ramjets Designed and fully developed by Bristol Aero-Engines, Ltd., the Thor is the power-plant of the twin-engined Bloodhound surface-to-air missile, which has been adopted as the standard R.A.F. weapon for the defence of the United Kingdom. Before the Thor could be placed in production—it was the first ramjet to be series-produced in this country—absolute reliability of operation had to be guaranteed in view of the immense importance of its rôle.

Bristol state that Thor-powered missiles "have flown faster, higher and over greater distances than any other British ramjet vehicle and have reached heights well above those at which manned aircraft are at present operated."



Bristol Orion. Split-compressor, power-limited turboprop. Seven-stage low-pressure compressor, five-stage high-pressure compressor, annular combustion chamber with ten flame tubes, single high-pressure turbine stage and three-stage low-pressure turbine coupled to the reduction gear and propeller. Diameter, 41.8in; overall length, 112.3in; dry weight, 3,150 lb; mass flow, 82 lb/sec; pressure ratio, over 10:1; maximum take-off power, maintained up to 15,000ft (i.s.a.), 5,150 e.h.p. (4,400 s.h.p. +1,950 lb thrust) at 10,000 l-p. r.p.m. with s.f.c. of 0.64; maximum continuous rating, maintained up to 25,000ft, 3,900 s.h.p.; cruising rating at 36,000ft at 350 kt, 3,300 e.h.p. with s.f.c. of 0.40.



Bristol Thor BT.1. Supersonic ramjet. Fixed-geometry double-shock intake, circular-section body housing diffuser and combustion chamber, centre-body housing fuel system, convergent/divergent propelling nozzle. Overall diameter, about 16in; overall length, about 109in; weight and performance, restricted. It has been stated that a theoretical horse-power of about 90,000 could be developed at Mach 3 at sea level.

British Aero Engines, 1957 . . .

THE DE HAVILLAND ENGINE CO., LTD.

Leavesden Aerodrome, Herts.
Telephone: Garston 4000.

Gyron Although official support for this engine was withdrawn earlier this year (for the apparent reason that there was no Government-sponsored application for it) de Havilland are continuing its development as a private venture, since it is undoubtedly the most highly developed unit in its class and could succeed in several major programmes both at home and abroad. The prototype first ran on January 5, 1953. In August 1955 the conservative DGy.1 rating of 15,000 lb-thrust was type-tested, and this was raised, without materially changing the design, to a figure of 20,000 lb (dry) in February of this year. With a simple reheat jet pipe and two-position nozzle the thrust is raised to 25,000 lb. Much higher thrust has been recorded by later engines.

A full description of the first-generation Gyron was published in our issue of August 2, and this revealed the inherent simplicity and "ruggedness" of the design. The compressor, in particular, is of advanced conception and comprises seven discs of progressively increasing diameter which are through-bolted together to form a rigid unit, the whole being driven by a large-diameter tubular shaft which flares out at the forward end to the full diameter of the rotor. As a result the engine has but two main bearings.

Gyron Junior Owing to its extreme importance as the powerplant of some of our most important military aircraft, the Gyron Junior may not yet be described in detail. It is, however, logical to assume that it has a configuration essentially similar to that of its larger ancestor (of which it is a two-fifths scale, on an area basis). The latter relationship indicates that its thrust will be a similar proportion of that of the Gyron, and the first rating to be announced is 7,000 lb.

Various types of Gyron Junior have been developed, and the basic engine is virtually ready for production. Such ancillary devices as afterburners, supersonic intakes, flap-blowing manifolds and a variety of accessories have also been associated with this engine and will probably appear in some of its applications.

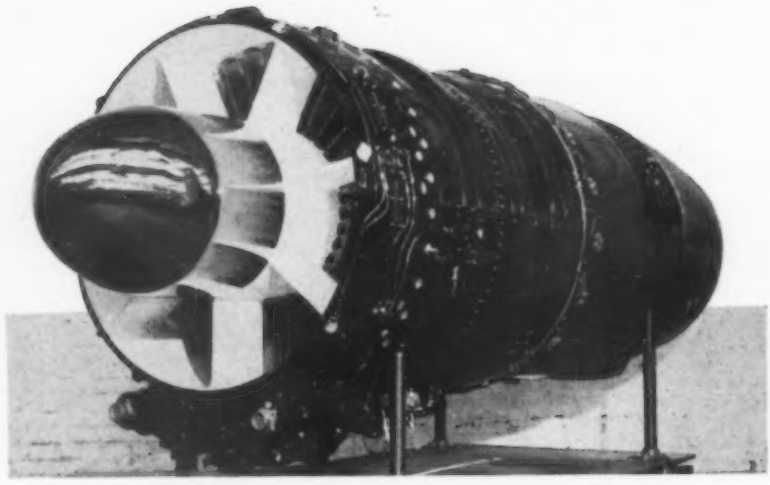
Less than a year from the first issue of drawings, the prototype ran in August 1955. Flight development started in May last, with a single Junior mounted in a Canberra; the flight programme will accelerate later this year when a Javelin will take to the air with a pair of reheat Juniors.

Piston Engines Most important of the six-cylinder Gipsy Queens are the Series 70 Mk 2 engine for the Dove and the Series 30 Mk 2 for the Heron. Their respective ratings are 380 h.p. and 250 h.p., and both remain in production.

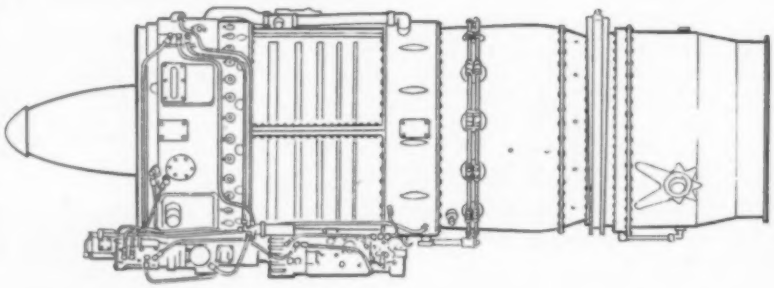
Considerable engineering development is being applied to the four-cylinder Gipsy Major and the increased-capacity 200-Series has now been developed into the Major 215 which powers the Saro Skeeter. Numerous detail improvements have been effected to increase the serviceability and output of the unit. An exhaust-driven turbo-supercharger is under development, which will permit the full-throttle power of 215 b.h.p. to be retained up to 4,000ft and I.C.A.N. +30 deg C (at sea-level, temperate, 222 h.p. will be available).

Spectre As the principal high-altitude powerplant of the Saunders-Roe S.R.53 mixed-power intercepter (and of other projects yet to come) the Spectre is one of our most important aircraft powerplants. Although one version is being developed as an a.t.o. motor—presumably for the Vulcan and/or Victor—the principal applications of the Spectre require a complete self-contained permanent powerplant capable of operation over long periods.

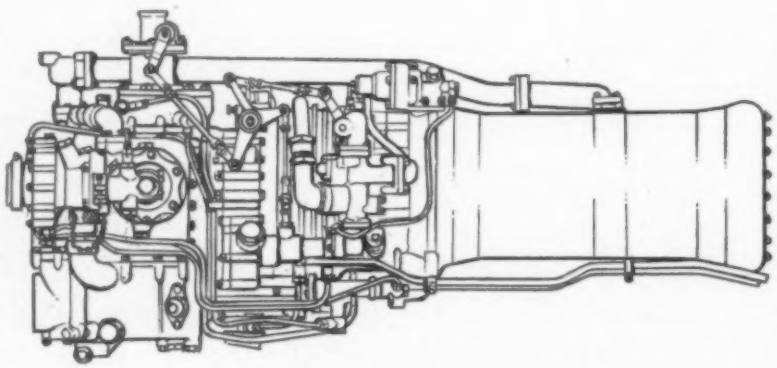
As was outlined in our description of the Spectre in last week's issue, the basis of the motor is a three-piece cylinder, about 13in in diameter and 44in in length, forming a high-pressure reaction chamber in which H.T.P. is passed



de Havilland Gyron DGy.2. Single-shaft turbojet. Seven-stage compressor, annular combustion chamber with 17 burners, two-stage turbine. Maximum height, 55.2in; maximum width, 49.9in; overall length, 121.3in without jet-pipe; dry weight, (no reheat) 4,270 lb; maximum dry thrust 20,000 lb with s.f.c. of 1.04.



de Havilland Gyron Junior DGJ.1. Single-shaft turbojet. Maximum height, 41.1in; maximum width, 32.3in; overall length, with starter bullet, 102.9in; dry thrust, 7,000 lb. More powerful versions of this engine are being developed.



de Havilland Spectre (sub-type not released). Aircraft rocket motor. Turbopump feed of H.T.P. and kerosine to single regeneratively cooled chamber. Overall diameter, 26.5in (32in over the mounting frame); overall length, 56.5in.

Personally speaking

—a series of contributions on questions of the hour by leading aviation personalities.

Professor THEODORE VON KÁRMÁN
requires no introduction. He is generally acknowledged to be the world's greatest living aerodynamicist.

Rocket into Cosmic Space

The velocity which any mass has to reach in order to escape from the gravitational field of our planet and enter into cosmic space amounts to about 25,000 miles per hour. It certainly is possible even by use of presently known propellants to build complex rocket motor systems which would be able to accelerate a relatively small mass to " escape velocity."

However, it appears to me that the use of nuclear energy will make the rocket so much more efficient that serious attempts to build a space ship should await the advent of the nuclear rocket. For a rocket using hydrogen or ammonia as working fluid and a nuclear reactor as heat source, the specific impulse of the working fluid can easily be made several times the present values for the usual propellants, without substantially raising the temperatures to which the rocket walls have to be exposed. Further developments in the use of nuclear processes for propulsion and in heat-resisting materials may allow even more significant improvements.

In the meantime, basic studies in aerodynamics and the physics of rarefied, ionized gases, study of radiation effects on material and humans, study of navigation and guidance problems at high altitudes and in space, the gradual exploration of the space surrounding our globe by high-flying manned airplanes, by sounding rockets and unmanned satellites should give the enthusiasts of space travel enough to do. I do not believe in reckless promotion. On the other hand, I think that the " respectable " scientific and engineering societies should not close their doors to the astronauts or the pages of their journals to papers dealing with the problems of space travel. The present congresses and meetings of the astronautical and interplanetary societies have a relatively high scientific level, specially if we compare them with the activities of certain aeronautical societies only twenty-five years before the first mechanical flight.

Perhaps the effort necessary to proceed from the present-day long-range, high-altitude rocket to a manned space vehicle is no more than the effort which led from the Wright brothers' airplane of 1903 to today's supersonic aircraft.

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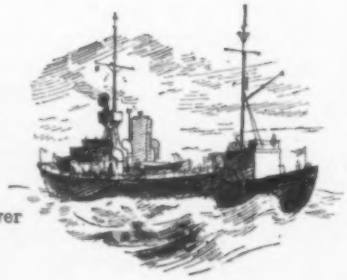

Now the aircraft is talking to a Weather Ship in mid-Atlantic.
Soon it will be calling Shannon, then London, Paris, Rome or Madrid.
Radio signals from the modern aeroplane are transmitted
and received on many different frequencies by a dozen or more sets.
Sometimes it is necessary to listen for calls from
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Ultra Communication Control Equipment is typical of the products of the Special Products Division of Ultra Electric Limited—applying modern electronics techniques to special problems of today and the future where the highest standards of design and manufacture are vital.

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through some form of catalyst pack to produce a propulsive jet of decomposed products at about 600 deg C. Into the latter is injected kerosine, which is first passed through a cooling jacket around the expansion nozzle which occupies roughly half the length of the engine. Both propellants are fed by pumps mounted on a gearbox casing at the front of the unit and energized by a turbine. The complete powerplant is controllable, from a single cockpit lever, over a wide range of thrusts and can operate either "hot" or "cold" (i.e., without kerosine). The first cold run took place in July 1953 and the first trial with kerosine injected in September of the same year. Since that time the Spectre has progressed through the various ratings between DSpe.1 and DSpe.5. Air trials have been in hand with a Canberra test-bed since December, and the first S.R.53 has been flying since May.

Super Sprite In this rocket motor de Havilland reached what is probably the optimum arrangement for a piloted-aircraft rocket unit at the present time: high-test peroxide fed through a silver-plated nickel-gauze catalyst pack, and kerosine injected into the resulting products of combustion to increase the specific impulse. The Super Sprite was the first unit to employ such a principle and it was also the first liquid-propellant rocket motor to go into production in Britain. Its sole application is the provision of additional take-off thrust for the Valiant medium bomber. The basic rocket motor is contained in a streamlined nacelle, one of which is attached beneath each pair of the bomber's main engines. After firing, the pack is jettisoned and is recovered by a parachute system for re-use.

Centrifugal Turbojets Both the Goblin and Ghost remain in production, principally for the Vampire Trainer and the Sea Venom FAW.22 respectively. In the former aircraft the usual unit is the Goblin 35 of 3,500 lb-thrust, and the latest Sea Venom is fitted with the Ghost 53 Mk 1 in which increased top-temperature permits operation at a rating of 5,300 lb dry-thrust.

D.H. Super Sprite. A.t.o. droppable rocket pack. Basic motor: length, 117½in, diameter, 20½in. Empty weight, 620 lb; fuelled weight, 1,460 lb. Standard thrust, 4,200 lb for 40 seconds duration; total impulse, 120,000 lb-sec. Propellants: 57 gal hydrogen peroxide at 80 to 85 per cent concentration and 5 gal jet fuel. Feed by 3,690 cu in nitrogen initially at 2,900 to 3,100 lb/sq in. Nacelle: approximate overall dimensions, length 150in, height 32in and width 28in. Total weight of nacelle and fuelled motor, about 1,900 lb; fall-weight during parachute-jettison cycle, 1,080 lb. The nacelle is shown being fuelled on a Valiant.

D. NAPIER AND SON, LTD.

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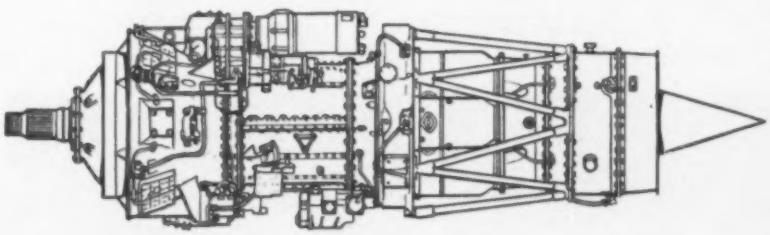
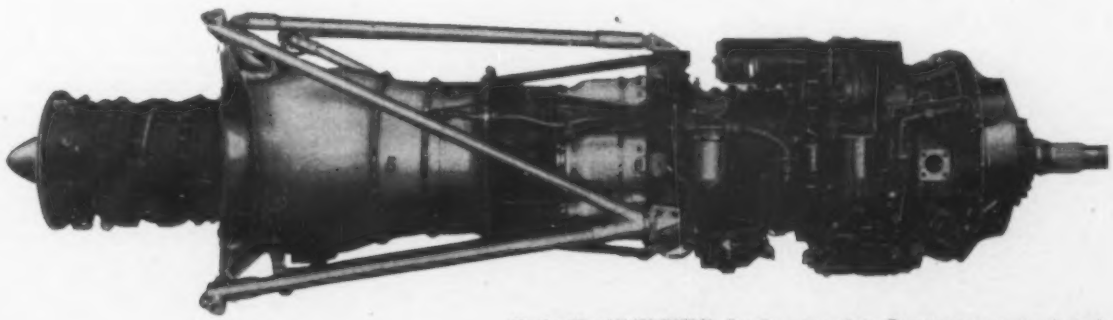
Eland Originally designed as a 2,500 s.h.p. turboprop for fixed wing aircraft, the Eland has now branched into a variety of configurations with ratings between 3,000 and 3,500 h.p. All utilize the same power section, among the features of which are aluminium-bronze compressor blading, mercury-vapour temperature control, oil coolers arranged in pads to heat the intake and a carcase which can readily be taken apart into major sections to ease operational overhaul.

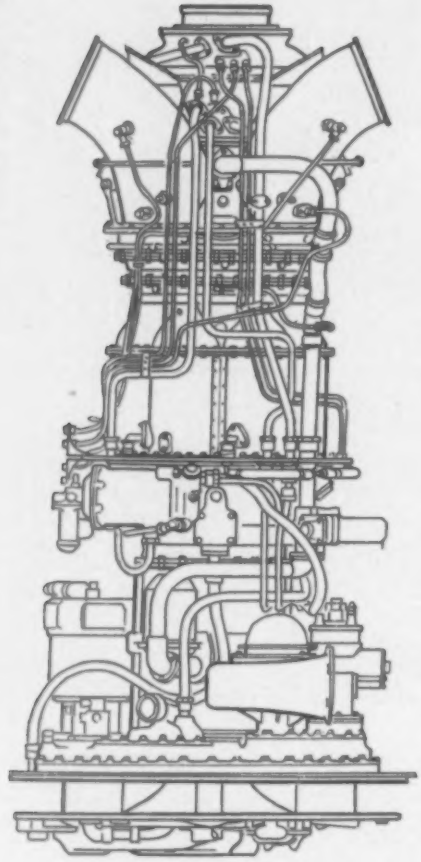
One of the most important Elands is the NEl.6 which is proving eminently suitable for instal-



Napier Eland NEl.6. Single-shaft turboprop. Ten-stage compressor, six combustion chambers and three-stage turbine. Overall diameter, 36in; length, 120in; equipped dry weight, 1,735 lb; mass flow, 31 lb/sec; pressure ratio, 7:1; maximum rating, 3,500 e.h.p. (3,150 s.h.p.) at 12,500 r.p.m. with s.f.c. of 0.595.

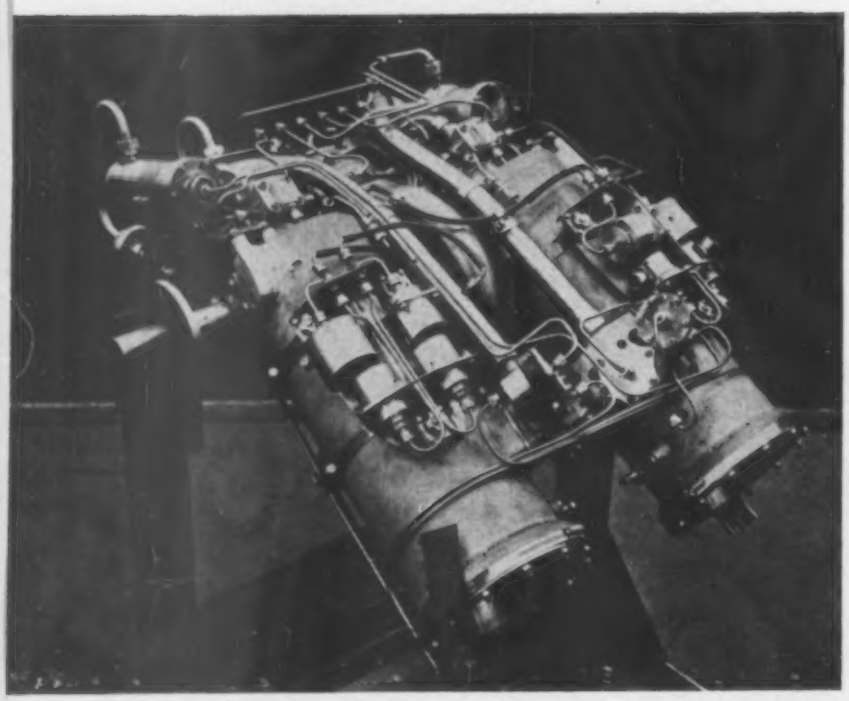


Napier Eland E.151 (NEl.3). Rotodyne powerplant. Ten-stage compressor, six combustion chambers and three-stage turbine, the rotating assembly being coupled to a propeller reduction gear at the front and (via a fluid clutch) a nine-stage auxiliary compressor at the rear. Overall diameter, about 40in (basic, 36in); length, 158.25in; dry weight 2,350 lb; mass flow, 31 lb/sec; pressure ratio, 7:1; maximum power (forward flight), 3,000 e.h.p. (2,800 s.h.p. + 500 lb) at 12,500 r.p.m. with s.f.c. of 0.624.



Napier Gazelle NGa.13. Free-turbine shaft-drive helicopter engine. Eleven-stage compressor, six interconnected combustion chambers, two-stage compressor turbine and single-stage power turbine. Overall diameter (intake casting), 33.5in; overall height, 70in; equipped dry weight, 865 lb; maximum rating, 1,800 s.h.p. (5-min limit) at 20,400 compressor r.p.m. with s.f.c. of 0.664, or 1,450 s.h.p. (one-hour) at 19,500 compressor r.p.m. with s.f.c. of 0.703. Note: this engine can be mounted at any angle and is shown in the vertical position.

Napier Double Scorpion. Liquid-propellant rocket engine. Two individually controllable chambers each fed with H.T.P. and kerosine by turbopumps. Each chamber appears to be regeneratively cooled and to have a diameter of about 8in. Overall length is about 30in and width about 25in. Aggregate thrust of both chambers is likely to be about 8,000 lb at sea level, or more at high altitude.



lation in existing piston engined aircraft. Test flying has already been conducted with a Convair 340, an Ambassador, and a Varsity and suitable applications include all the Convair-Liners, the DC-6, the Constellation and other similar types. R.E.A.L., a major Brazilian operator, has signed a contract for the conversion of Convairs, and several other operators are holding discussions. The NEI.6 has also been proposed for several new designs of fixed wing aircraft.

The remarkable E.151 for the Fairey Rotodyne convertiplane comprises a basic Eland fitted with split exhaust ducts and a main shaft extended to the rear behind the turbine and driving an auxiliary compressor through a hydraulic coupling. This auxiliary compressor feeds air to pressure jets at the tips of the rotor blades; in cruising flight the rotor autorotates and all power is absorbed by the propellers. Yet another helicopter-type Eland is being prepared for the Westland Westminster. In this case a shaft drive is taken out at the rear end through a large gearbox provided with free wheels to couple the output from two Elands to the single rotor.

Gazelle One of the most efficient and neat gas turbines in production, the Gazelle has been designed initially as an omni-angle engine for helicopter propulsion. A single NGa.13 is mounted at about 35 deg inclination in the nose of the Westland Wessex anti-submarine helicopter of the Royal Navy. Compared with the piston engine previously fitted, the Gazelle provides comparable power for greatly reduced weight and gives much smoother and quieter operation; it could also be argued that the use of kerosine reduces fire risk. Flight trials with a prototype Gazelle-Wessex began in May and the engine flew for over an hour the first time it left the ground. A similar Gazelle recently completed three complete 150-hr rehearsal type tests to the new and more arduous schedule and was only removed from the bed after 560 hr of running.

A related engine is the NGa.2 for the Bristol 192 multi-purpose helicopter of the R.A.F. In this aircraft one Gazelle is mounted vertically beneath each rotor and to provide maximum single-engine performance the engine has an emergency rating of 1,650 s.h.p.

Ramjets For several years Napier have been major sub-contractors to the National Gas Turbine Establishment in the design and manufacture of supersonic ramjet vehicles but no details may be given of their present work in this field.

Rocket Motors For several years Napier have been engaged in the development of a number of types of rocket motor for both aircraft and missile applications. Single-chamber liquid-propellant motors were exhibited at both the 1955 and 1956 S.B.A.C. Shows and the characteristics of these indicated that they were designed for test vehicles and guided weapons. Typical of these early designs are the NRE.11 and the more refined NRE.17.

The photograph on the left is the first to show the Double Scorpion pump-fed motor for piloted aircraft. Extensively developed in a Canberra test-bed, this twin-chamber motor is likely to go into production for a supersonic aircraft At the recent Paris Salon a mock-up of a single-chamber motor of Scorpion type revealed a pump feed and what appeared to be an exhaust pipe for decomposed H.T.P. from the pump-turbine. A similar design of chamber is used in the twin-barrel Scorpion illustrated, inspection of which is most instructive. A similar type of unit is expected to be exhibited at the forthcoming S.B.A.C. Show.

A quite different type of rocket-motor development by Napier is that associated with the provision of tip-drive boost motors for helicopters. Developed with a Bombardier-powered Skeeter, the system consists of a tank of H.T.P. mounted above the rotor hub and small catalyst packs at the blade tips feeding "cold" rearward-facing propulsive jets.

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to intercept at extreme height
to strike at low altitude

GYRON JUNIOR — SPECTRE

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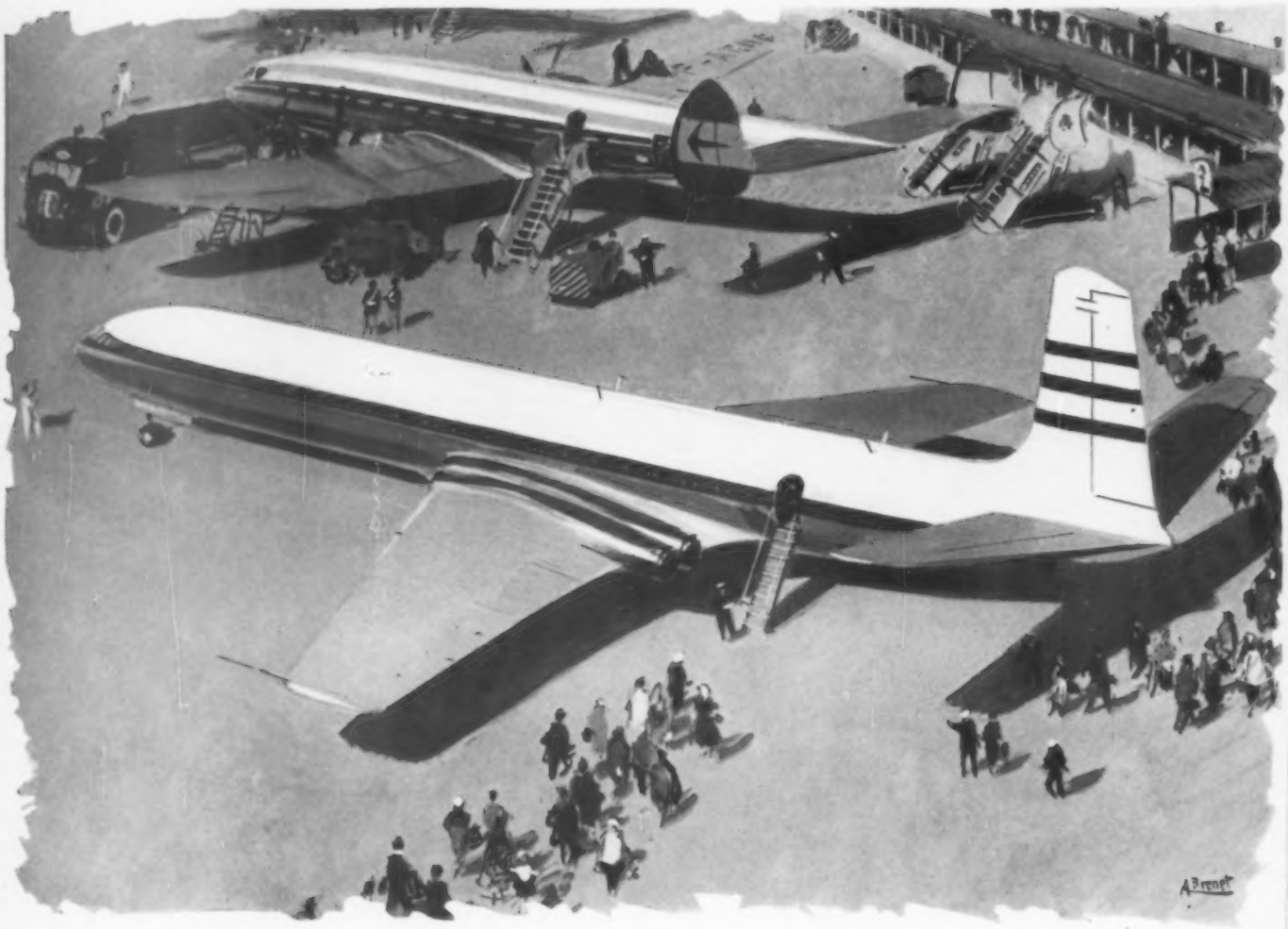


Master of the routes of moderate traffic density—

DE HAVILLAND WORLD

The pictures show how independent the Continental version of the Comet is of airport services at intermediate halts. This aircraft has a self-contained gas-turbine unit which supplies power to lower and raise a built-in stairway, as well as providing cabin ventilation and cooling, also electrical services, while on the ground — and engine-starting for departure. The "turn-around" can be cut to a few minutes— as it needs to be for an inter-city liner which cruises at 545 miles per hour, even faster than the Intercontinental Comet.

The New Comet is the only developed jet airliner in the world.

The Intercontinental version will be operating on the services of B.O.A.C. by 1959. At 500 miles an hour the Comet can fly from England to Australia in less than a day and a half.

It is specifically designed to bring the incomparable comfort and speed of jet travel to the many world routes on which main cities are up to 3,000 miles apart. It pays its way on moderate traffic, uses airfields of ordinary size.

Its quietness has been demonstrated and acclaimed around the world.

It has power to spare, ensuring a short take-off and an easy, capable climb. It lands slowly.

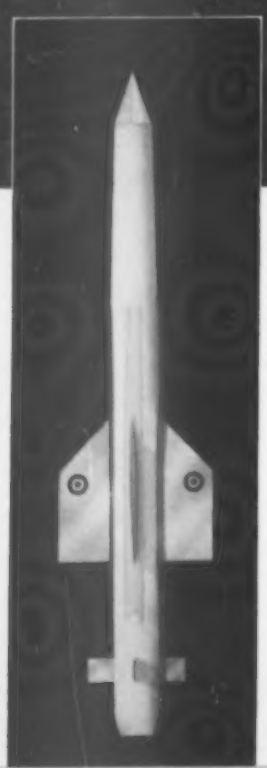
Its Rolls-Royce Avon engines are backed by a million hours of operating experience, and are never highly stressed in service. These features are important to safety as well as to comfort.

Its economy rivals that of any type of airliner—even on short inter-city stages.

The New Comet is first in the field of medium-capacity jet transport, of which it has the mastery.

The New COMET

ENTERPRISE



Firestreak at Farnborough

For the first time de Havilland Propellers Limited exhibit Firestreak, their air-to-air infra-red guided weapon.

Other products of the Company, equally important and advanced in design, are shown—propellers, radar scanners, turbo-alternators and aircraft air-conditioning equipment, all of which are in production for contemporary aircraft. **STANDS Q and 35.**

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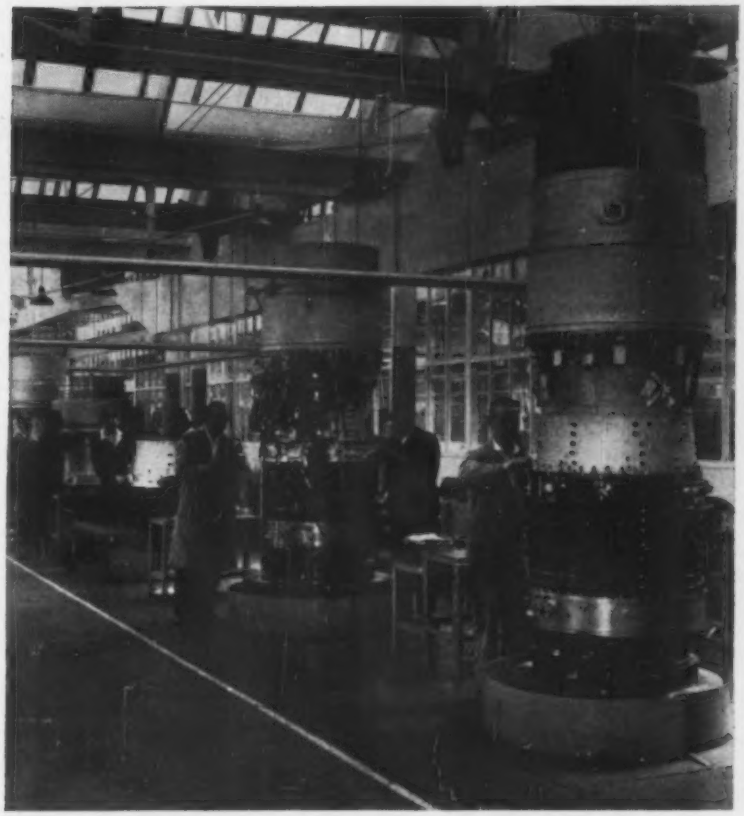
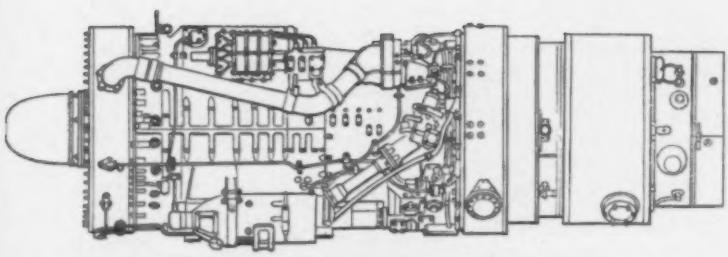
British Aero Engines, 1957 . . .

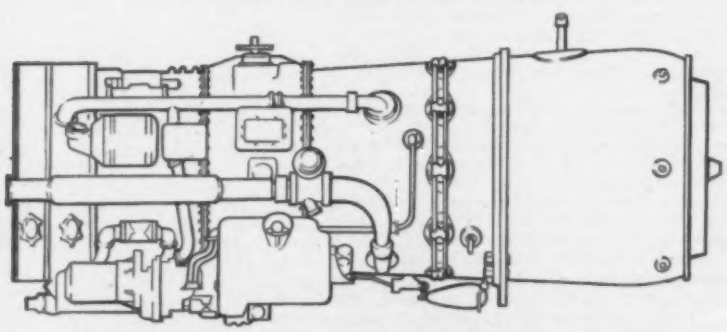


Rolls-Royce Avon RA.24. Single-shaft turbojet. Multi-stage compressor (15 stages in the related RA.28), can-annular combustion chamber with eight burners, two-stage turbine. Overall diameter, 41.5in; overall length, approximately 113in; maximum dry thrust, without reheat, 11,250 lb. All other data on this engine are restricted.

200-series Avons are in production for a wide range of military and civil aircraft. Like the earlier 100-series, the engines are assembled in the vertical position, as this photograph shows.



Rolls-Royce Avon 524 (RA.29 rating). Single-shaft turbojet. Sixteen-stage compressor, can-annular combustion chamber with eight fuel injectors and three-stage turbine. Overall diameter, 41.5in (carcase diameter, 36in); overall length, as illustrated, 124.8in; dry weight, 3,326 lb; maximum thrust, 10,500 lb at 8,000 r.p.m. with s.f.c. of 0.775. All other data restricted.



Rolls-Royce Conway 505 (RCo.10 rating). Two-spool by-pass turbojet for commercial transports. Multi-stage low-pressure compressor, flow-divider, multi-stage high-pressure compressor of smaller diameter, annular combustion chamber with ten Duplex burners, independent high-pressure and low-pressure turbines and inner and outer jet-pipes. Overall carcase diameter, 42in; overall length as depicted, 132.45in; maximum thrust, 16,500 lb. All other data restricted.

ROLLS-ROYCE, LTD.

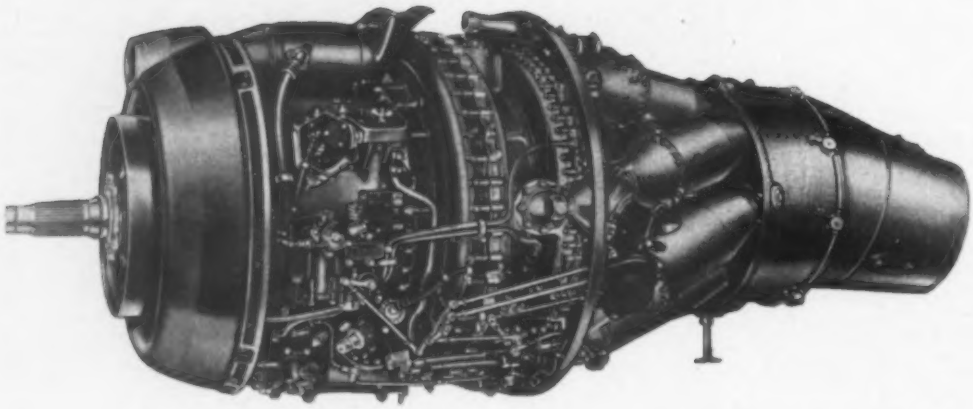
Nightingale Road, Derby.
Telephone: Derby 42424.

Avon Possibly the most important engine in the British Commonwealth, the Avon remains in very large scale production for a wide range of military and naval aircraft, and a substantially redesigned development is entering production for commercial transport purposes. The earlier Avon 100-series, distinguished by their separate combustion chambers, are no longer in bulk production but several thousands are in R.A.F. service with such aircraft as the Hunter, Canberra and Comet, and similar engines are made in Australia and have been built in Sweden and Belgium.

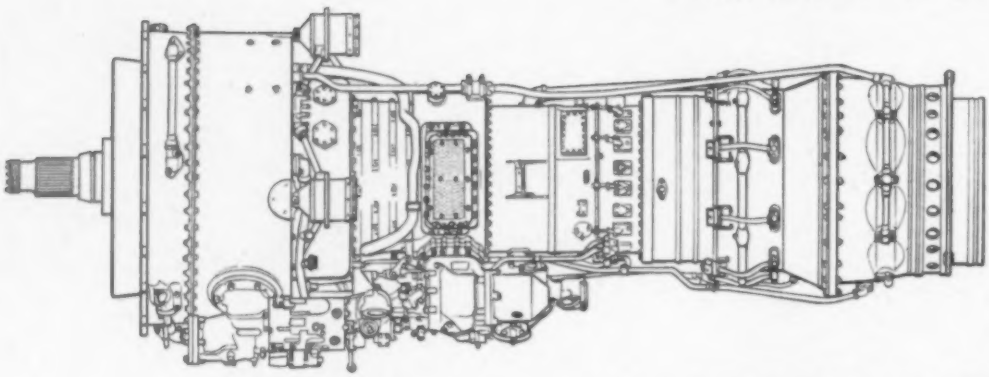
The Avon 200-series, which is now also being mass-produced in Sweden and Belgium, have ratings of 10,000 lb and upwards. One of the later "hot" military units, the RA.24, has a dry thrust of 11,250 lb which can be substantially increased with reheat. The most advanced Avons of all are those to the RA.29 specification in which additional compressor and turbine stages give outstanding economy. The first engines of this airline family are rated at 10,500 lb with a very low top temperature; later versions will be considerably more powerful.

Conway This engine is unique in that it is a highly developed by-pass engine, i.e., a unit in which the intake air is split into a central portion, which goes through a high pressure compressor, the combustion chamber and turbines in the usual manner, and an outer flow which is by-passed around the rest of the engine and emerges as a cool, relatively slow moving jet which increases the propulsive efficiency of the unit as a whole and should also make for quieter operation.

At present being intensively developed for service next year are two exceedingly powerful Conways designated RCo.10 and RCo.11. The



Rolls-Royce Dart 520 (RDa.7/1). Single-shaft turboprop. Two centrifugal compressors in series, seven canted combustion chambers and a three-stage turbine. Overall diameter, 38in; length, 98in; dry weight, about 1,250 lb; mass flow approximately 22 lb/sec; pressure ratio, 5.75:1; maximum rating, 1,890 e.h.p. (1,700 s.h.p.) at 15,000 r.p.m.; typical cruising output at 20,000ft at 300 kt, 1,145 e.h.p. (1,075 s.h.p.) at 13,400 r.p.m. with s.f.c. of 0.6.



Rolls-Royce Tyne (RTy.2 rating). Two-spool turboprop. Multi-stage low-pressure compressor, multi-stage high-pressure compressor, can-annular combustion system, single-stage high-pressure turbine and three-stage low-pressure turbine driving l-p. compressor and propeller. Overall diameter, 40.5in; overall length, 100.25in; dry weight, approximately 2,000 lb with full equipment; mass flow, 46 lb/sec; pressure ratio, 13:1; maximum rating, 5,315 e.h.p. (4,810 s.h.p.) at 15,250 l-p. r.p.m. The cruising specific fuel consumption will be about 0.4.

British Aero Engines, 1957 . . .

former, depicted by a diagram, is on order as the powerplant of a variety of modern jet transports including the Boeing 707, Douglas DC-8 and Vickers-Armstrongs VC-10. The RCo.11 which has a rating of 17,250 lb is in production for the Handley Page Victor B.2 and is about to fly in an Avro Vulcan test-bed.

R.B.108 No details may yet be published of this neat lightweight turbojet which probably is descended from the Soar engine. Five R.B.108s are fitted to the Short S.C.1 experimental aircraft, one being used for forward propulsion and the remainder (pointing downwards) for vertical lift.

Dart One of the most long-lived and trouble-free engines in the world, the Dart has flown some three million hours in the Viscount and is in production for a wide variety of new and projected transport aircraft. In the French Bréguet Alize it has also found a military application.

Most of the engines at present in service are of the 510-series of 1,742 e.h.p. The Dart illustrated is now flying in the new Viscount 806/810 and later engines such as the Dart 545 for the Viscount V.840 will have cooled blades and a new reduction gear capable of transmitting well over 2,000 s.h.p.

Tyne Originally intended to be a turboprop rated at about 2,500 h.p. the Tyne now gives double this power and is probably the most compact and economical unit in its class anywhere in the world. Details of its interior may not yet be disclosed owing to detailed similarity to military engines such as the Conway, yet superficial examination shows that the design is of an exceedingly advanced nature. Prototypes have been undergoing bench development since April 1955 and the first flight took place in June of last year with a single Tyne mounted in the nose of a Lincoln.

An Ambassador test-bed powered by two Tynes will shortly begin flying and the first V.951 Vanguard for which the Tyne is the standard engine is due to take the air in about twelve months' time. Other possible applications include versions of the Beverley and Armstreng Whitworth Freightercoach and the DC-7T/DC-10. Later versions of the engine give substantially more power than that quoted beneath the diagram.

Other projects Although no details of current work may be given it is known that Rolls-Royce are active in the fields of rocket motors and nuclear propulsion. In the latter field the company are working on the powerplant of a nuclear submarine; large rocket motors are being designed in collaboration with North American Aviation, presumably for the British 2,000-mile ballistic weapon.

ACCESSORY DEVELOPMENTS

THIS yearly review of airborne equipment manufactured by associate firms of the Society of British Aircraft Constructors, surveys the whole wide field of the British ancillary industry. Whether the design of the equipment is new—and much original thought is revealed year by year—manufactured under licence agreement from abroad, or the development of an established unit or prototype, the quality of the industry's products is of a praiseworthy standard, as foreign importers can testify. And growing competition in each specialized field means a wider and more satisfactory choice for the purchaser.

Changes of emphasis within the aircraft industry during the past months have inevitably been reflected in the design offices of the accessory manufacturers. On every hand, firms are widening their scope to include the extremes of miniature components for guided missiles, and new equipment for civil transports. Encouraging progress in developing equipment to go long periods without overhaul can be reported. Although orders for military types may be on the wane, there is still plenty of room for the best in the year of civil expansion ahead.

Lockheed "long-life" hydraulic components. (See "Automotive Products," in col. 1 below.)

Airscrew Company and Jicwood, Ltd. A new range of medium pressure centrifugal blowers, and a new prototype of a miniature three inch diameter, multi-purpose axial flow fan which can be used for cooling electronic equipment, have been produced by this Weybridge concern.

Among the company's range of blowers are cabin recirculation fans for the Viscount 700 and 800 series aircraft. The units for the latter are six inch diameter two-stage axial flow types—smaller than those for the 700 because of the variation in duty required. In both series a small centrifugal fan is employed for demisting the windscreen. Both fan and unit are made mainly in magnesium alloy castings. A further unit, with a contra-rotating fan ten inches in diameter, is used for heating the Beverley cargo hold, and other units of various sizes are in service on the Victor and Westland Dragonfly. A special 6½in diameter centrifugal fan with pneumatic oil seals is supplied for oil cooling on the Napier Gazelle.

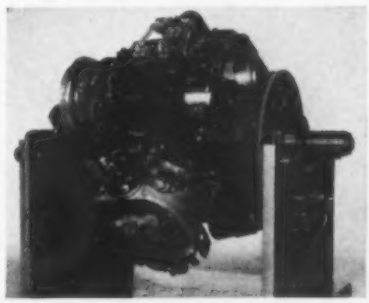
A new fixed pitch propeller—a rarity in this review—is being supplied to M.L. Aviation, Ltd., for use on the M.L. Mark 1 inflatable wing aircraft.

Automotive Products Co., Ltd. Civil transport operators, in particular, demand equipment with extended periods between overhauls. A range of products developed by this company—whose equipment is specified for the Comet and Caravelle—meets this requirement. Typical examples of the overhaul lives of Lockheed components chosen for the Comet 4 series are: pumps 5,000 hr; accumulators and selectors, 10,000 hr; hydraulic jacks, 5,000 hr; and powered controls, 2,500 hr. All these components meet both C.A.A. and A.R.B. requirements.

The company also supply hydraulic equipment for the Viscount, Vanguard, Beverley, Pioneer and Twin Pioneer, Herald, Accountant, Freighter Coach, and Agricola. This includes Avery hoses, self-sealing couplings and Purolator filters. A new bulk-fuel filter separator extracts from fuel both water and solid particles down to five microns in size; an additional filter for either function is not required. The filter is intended for aircraft refuelling installations and will be produced in a range of sizes giving flow rates of 250 to 750 gal/min.

Boulton Paul Aircraft, Ltd. In recent years, an increasing number of manufacturers have been demonstrating electrically-signalled powered flying controls. To Boulton Paul falls the distinction of being the first manufacturer successfully to fly such a system (it was coupled to an aileron jack). A new powered control for a heavy bomber's ailerons incorporates a swashplate hydraulic pump instead of the radial pumps previously standardized, and an economy in overall dimensions and weight has been effected thereby.

The company is also developing a design of thin wing—featuring integral construction—and various electronic components. New among the latter are packaged accelerometer equipment and a three-channel automatic strain-gauge bridge.



S. G. Brown master reference gyro.

British Oxygen Engineering Co., Ltd. After three years' work in collaboration with the M.o.S., this company has produced a new liquid-nitrogen system for creating an inert atmosphere in aircraft fuel tanks. They have also produced emergency breathing equipment for passengers of civil transports, a provision that so far has found more favour abroad than in this country. The firm are already supplying oxygen demand regulators for the crew positions in the Britannia and will do so for the Comet.

Much has recently been heard about aircraft liquid-oxygen breathing systems. For these British Oxygen make a new and improved 3.5-litre converter and a 5-litre Lox converter and container with capacitance gauging, pressure raising and economizing circuits, charging connection, vent and build-up and relief-valve assemblies.

British Oxygen Gases, Ltd., another company of the group, are responsible for some important new Argonarc welding techniques (see *Flight*, August 2, p. 172).

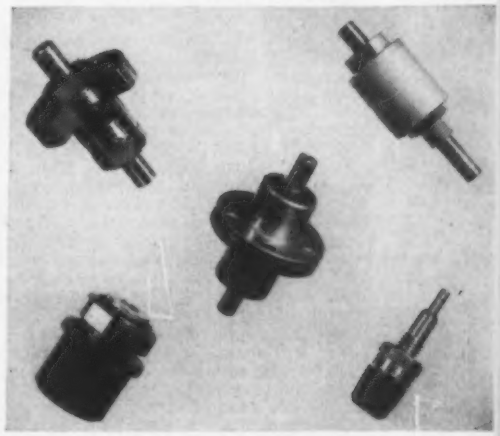
The British Thomson-Houston Co., Ltd. A new range of silicon rectifiers and reference diodes has been added to the B.T.H. line. They have many aircraft applications because of their ability to operate at very high temperatures. The reference diodes can take up to 250 deg C and the rectifiers to 200 deg C.

S. G. Brown, Ltd. Manufactured for use with new instrument presentation systems is the master reference gyro Type A5. This is claimed to be the only one in production (it is being installed in military aircraft) in the world; and it forms an important part of the Kelvin and Hughes flight data system. This firm also manufacture for the M.o.S. a pneumatic aileron-actuator for a missile application; aircraft torpedo control gyros; airborne radar stabilizer equipment; precision potentiometers; and fractional h.p. motors.

Brown Brothers (Aircraft), Ltd. A new component offered by this long-established manufacturer of A.G.S., B.S., and S.B.A.C. standard parts and other components is the Hy-Seal hermetic coupling. This is claimed as the "first and only coupling which permits a shaft to be rotated inside a closed chamber by mechanical drive from the outside while maintaining a positive hermetic seal."

In principle, the coupling consists of

Brown Brothers Hy-Seal couplings.



de Havilland H.T.P. auxiliary power unit.

ACCESSORY DEVELOPMENTS . . .

separate input and output shafts joined by a loosely fitting inclined pin, the ends of which consequently trace out a conical path when the input shaft is rotated. Around the centre of the pin is bonded a diaphragm seal, clamped around its outer periphery by the halves of the seal housing. Thus, although the seal deflects, it does not rotate, and complete sealing can be achieved between the driving and driven shafts. The coupling is available in a range of sizes and is suitable for use with pressure and vacuum vessels and a variety of liquids.

Chloride Batteries, Ltd. Recent developments in Drydex batteries include those for transistorized equipment. Among these is the Drydex leakproof cell unit Type T21 and a series of layer-built batteries of the Drymax type. These are produced in various shapes, sizes and capacities for airborne and ground electronic equipment.

Two new batteries that have just become available are the Exide "ultra-lightweight" 6MNA17 and 4MNB17 types. They are unspillable and are claimed to have very low open-circuit losses. The former is a 12-V unit for airborne V.H.F. equipment and the latter an 8-V unit for valve-operated electronic apparatus. (The unusual 8-V rating is to meet the demand for batteries required to work with 6.3-V valves where the terminal voltage must not fall below 6-V.)

Other batteries which have been subject to development during the past year are the Exide 12ZD13R, 24-V, 25 amp-hr unit, which has been produced in a ventilated version for the first time this year. An example of other development work is the production of a three-cell lead-zinc primary battery for energizing radar sonde equipment.

de Havilland Engine Co., Ltd. To satisfy the need for an auxiliary power unit that will operate at altitudes up to and beyond which oxygen is present in barely usable quantities, the Engine Company have for some time had under development an A.P.U. running on high test peroxide. It is available in several different forms to suit particular applications—the differences lie largely in the control and pump arrangements and not in the basic turbine. The unit is eight inches in diameter and about eight inches long. A centrifugal pump supplies H.T.P. to a stationary catalyst and a partial-admission impulse turbine which converts the steam energy, created by decomposition, into torque. The working pressure of the pump and the capacity of the catalyst pack can be altered to give maximum outputs of between 20 and 50 b.h.p. The weight of a typical unit is about 23 lb. The H.T.P. is stored in a remote tank; on a mixed powerplant aircraft the main storage fuel tank for the rocket would be used. A typical consumption figure is 9 lb (0.65 gal) per min for a unit developing 25 b.h.p. at 33,000 r.p.m.

Development has also continued with the range of de Havilland turbo-starters—compact units capable of rapidly accelerating large engines and functioning with great reliability. The units can be mounted in the intake bullet, as decomposed H.T.P.—being non-corrosive and inert—can pass through the engine without harmful effect. The fuel is supplied to a catalyst pack at about 250 p.s.i. where it is decomposed into superheated steam and pure oxygen at a temperature of 600 deg C. The gaseous mixture is directed through a full-admission fixed-nozzle assembly on to the blades of a single-stage turbine and exhausted into the engine intake. About 11 lb of peroxide is used per start. The developed unit, with its integral gearbox, is 15.6in long and 5.8in diameter. It weighs 46 lb.

de Havilland Propellers, Ltd. During the past twelve months, the trend of propeller development has been towards increased safety and refinement of control: at the same time new propeller designs have been emerging to meet ever-increasing engine power and flight speed.

D. H. Propellers, Ltd., cold air unit.

New features which have been introduced consist of mechanical pitch-locks which are responsive to either loss of propeller control oil pressure or to an overspeed signal, and a drag-limiting device which limits propeller pitch on receipt of a mechanical signal from an annulus gear situated in the engine reduction gear.

The overspeed-conscious device has a triggering datum which is varied with throttle position. At cruise throttle setting the overspeed setting is three per cent above maximum continuous r.p.m., and at take-off throttle setting the overspeed setting is three per cent above maximum. In the event of an overspeed occurring, the mechanical pitch-lock is brought into operation and remains engaged until a coarse-pitch signal is received. The drag-limiting device is similarly reset by throttle movement. At any throttle setting above flight-idle, if the torque in the propeller shaft falls to a low positive value the increase-pitch valve in the propeller controller is operated. At flight-idle throttle setting the increase pitch valve is operated when the torque in the engine shaft reaches a pre-set negative value.

"Beta" control has been developed to give the pilot control of blade angle when the throttle is moved below the flight-idle position after touch down. The pilot thus has a large range of positive and negative blade angles available for stopping the aircraft and for manœuvring on the ground.

Synchrophasing has been on flight trial during the last twelve months and will be a feature of the Vanguard aircraft; not only are propeller r.p.m. matched one to another but the phase relationship is rigidly controlled with a view to cancelling out the pressure waves from propeller blades on opposite side of the aircraft. Noise reductions of the order of six decibels have been achieved.

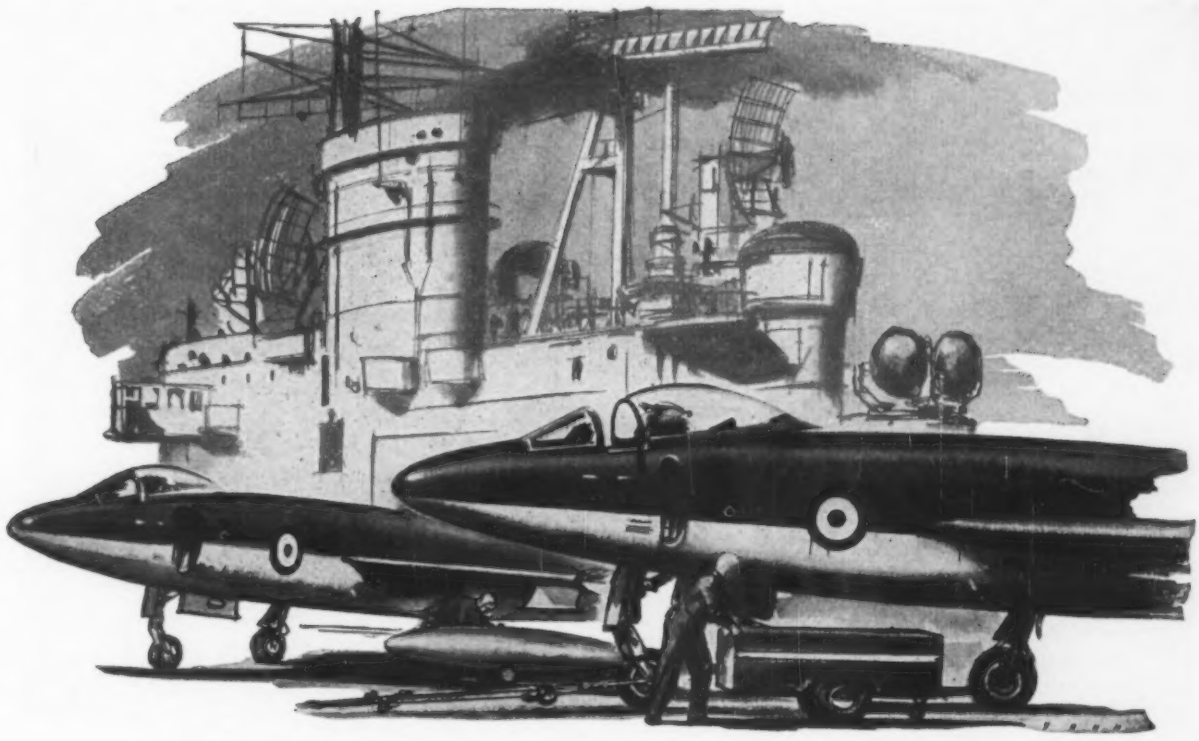
In other fields, this company has also designed and put into production, for missile purposes, a range of small high-frequency single-phase alternators, complete with drive and control gear. This equipment is now supplied for the majority of the anti-aircraft missiles now in production in Great Britain. Powers range from 300 W to 3 kW intermittently rated, and over 3 kW continuously rated, using various prime movers including oil, air and monofuels. Where required, a tandem arrangement of high frequency single-phase and a small 40 c.p.s. three-phase supply is arranged on a common drive. Inductor-type alternators are used for simplicity, but the high inductive reactance necessitates capacitors in series with the output windings to increase the output power. These capacitors are sometimes separately boxed for convenience of installation.

A hydraulic scanning unit, intended for use with the most advanced types of air interception radars in fast all-weather fighter aircraft, has also been developed. It is a combined search and lock-follow scanner, space stabilized in three axes, and embodies instrumentation for feeding appropriate information into autopilot and weapons guidance systems. The use of hydraulics as a power source has enabled a superior degree of accuracy and frequency response to be achieved.

The company's work on cold air units is well known. One such unit, now undergoing extensive flight testing in the Comet 3, is a turbo-fan type operating at a normal maximum speed of 36,000 r.p.m. which passes 80 lb/min of air at rated conditions. It will be used in the Comet 4. A Durestos fan housing, developed by the Plastics Division of D.H. Propellers, weighs some 3 lb less than the design previously used.

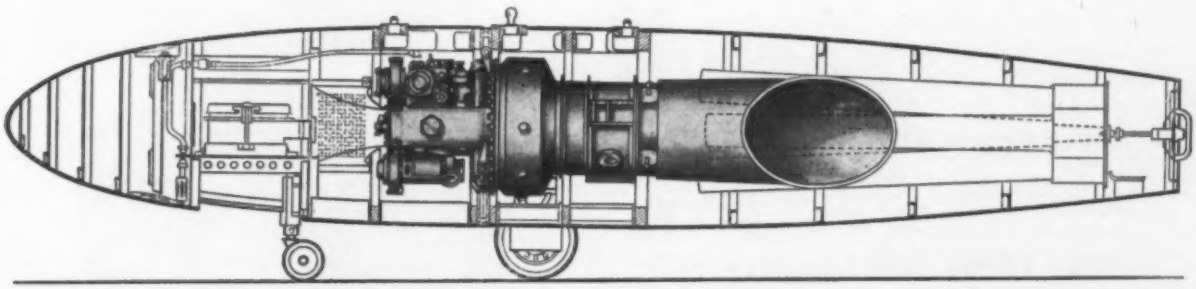
Delaney Gallay, Ltd. New techniques and methods of manufacture have enabled the Delaney Gallay high-temperature insulating blanket to be made for a lower weight penalty than was previously the case. The company's advancing metallurgical knowledge, which made possible the design of jet-pipe blankets, has also been applied to methods of bonding metals. Particular applications are aluminium brazing by up-to-date salt-bath techniques and the welding of 0.004in thick stainless steel sheet to give a reliable joint with relatively high structural strength and the non-corrosive quality of the sheet.

Twelve months after first showing their new design of aircraft stainless-steel toilet, Delaney Gallay have announced a weight reduction from 42 lb to 26 lb. These units present some unique problems, but this design suggests a significant step for-



Hand starting a jet . . .

not the main engine but the Palouste air-bleed jet engine which powers the newest starter pods and trolleys for high-performance aircraft jet engines. The Blackburn Palouste 500 is a single-shaft, 2-stage, axial turbine with an annular combustion chamber and air bleed, providing 2.65 lb./sec. air at 56 p.s.i.a. Mounted in a ground starter trolley the overall length of the complete equipment is 8′ 11″, width 5′ 3″, height 3′ 7″.



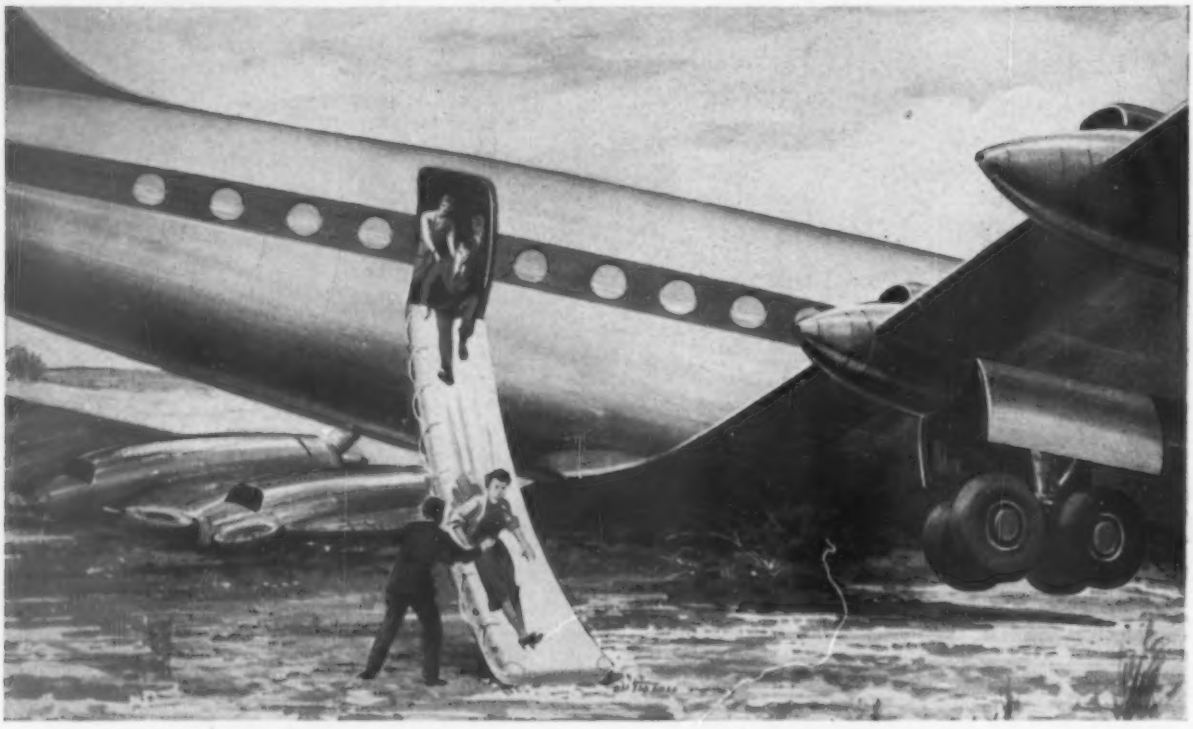
The sectional drawing shows the Blackburn Palouste installed in an air-transportable pod which can be attached to pylons under the aircraft wing. An inbuilt undercarriage enables it to be used for Squadron Service at advanced airfields.

"Palouste"

LOW-PRESSURE AIR STARTERS

Blackburn and General Aircraft Limited. **ENGINE DIVISION** *43 Berkeley Square. London. W1*

A 89/a



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Dowty Group, Ltd. The principal member of the Dowty Group, Dowty Equipment, Ltd., has recently designed and produced an interesting power-operated flying control valve—the heart of any aircraft powered flying control system. The valve unit is of the type for piloted aircraft and incorporates autostabilization for stability augmentation during supersonic flight. This function is effected through hydraulic controls actuated by torque motors receiving signals from sensing gyros located in the aircraft.

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Dowty main undercarriage leg for the F.27.

Other new components with specific guided missile applications are a fixed-displacement pump operating at 8,000 r.p.m. and 3,000 p.s.i.; a miniature high-speed pump weighing 12.8 oz; a piston-driven ten-cylinder axial hydraulic motor; single and two-stage servo valves of the type used in the missile's guidance-fin circuit; high and low pressure accumulators, and a reservoir operating at a nominally constant pressure.

Production continues at Cheltenham of undercarriages embodying the Dowty features of controlled articulation and "Liquid Springing." Some of the latest undercarriages thus equipped are the eight-wheel bogies for the Vulcan and the landing gear of the Lockheed F-104 Starfighter. A civil undercarriage is that for the F-27 Friendship; illustrated in the photograph, this is a good example of a landing gear for a high-wing aircraft. "Super Vardel" pumps for pressures up to 4,000 lb/sq in and incorporating a built-in wave filter to eliminate pressure ripple also continue in production.

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Dunlop pressure impulse counter.

pressure vessels where the critical factor is the number of impulses to which they will be subjected during service.

The unit measures 2⅞in by 1½in by 1½in and is designed for a maximum working pressure of 2,500 lb/sq in. A typical setting would record impulses each time system pressure drops below 500 lb/sq in and then rises to 1,800 lb/sq in; pressure impulses within these limits would not be recorded. Other settings can be supplied for particular requirements.

The firm have also developed a propeller brake, weighing 24 oz, to reduce airport turn-round times by enabling propellers to be quickly stopped after taxi-ing. It works on the Dunlop disc-brake principle.

Ekco Electronics, Ltd. Airborne search radar from this firm is installed in the Britannia, and new X-band equipment Type E160 is intended for the Comet 4, Vanguard, and Boeing 707. Newer still is C-band equipment which is as yet in prototype form.

The search radar scans a sector of space ahead of the aircraft to a maximum range of 120 miles, and provides warning of turbulence within cloud formations on a P.P.I. display. The Iso-Echo contour feature gives visual distinction on the screen between the degrees of turbulence, and the equipment also provides land map-painting facilities as an aid to navigation. Recently introduced is the Ekco Doppler drift measurement unit which can be added to facilitate dead-reckoning navigation.

The new E160 3.2 cm equipment employs a simplified stabilization system in which pitch stabilizing and tilt are combined and cover ±25 deg. Roll limits are ±45 deg and the scanner sweeps ±90 deg about the aircraft heading. Provision is made for switching the pencil beam to an equal-energy-distribution beam to give improved map-painting facilities.

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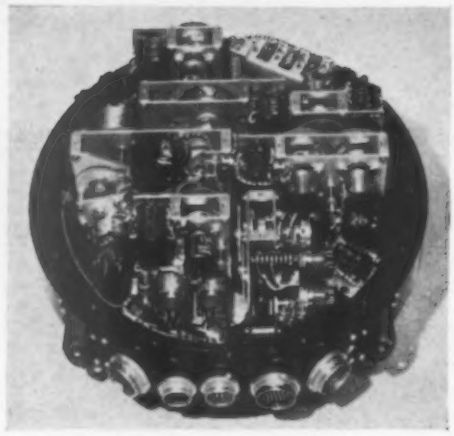

(Above) Firth Cleveland Instruments fuel flowmeter equipment. (Left) Elliot air-data computer.

ACCESSORY DEVELOPMENTS . . .

fier processes the signals and supplies power for the system; and an indicator shows fuel flow with a needle and "fuel gone" on a veeder counter.

The English Electric Company, Ltd. (Aircraft Equipment Division). For the first time, new products produced by the division include some for guided weapons. Past experience of alternating current aircraft electric systems has been put to use in the development of a three-inch missile alternator. This is rated at 750 VA and weighs 3 lb 10 oz. New motors have been produced for submerged fuel pumps. Both A.C. and D.C. designs have been developed, and the motors run submersed.

Production of a wide range of A.C. and D.C. machines has been expanded in the past twelve months, and the range of products also embraces universal actuators and control gear.

Ferranti, Ltd. A new artificial horizon from Ferranti, the Type F.H.9 (Mk 4c) has a presentation designed to enable a pilot to determine his attitude more positively and quickly (particularly in inverted flight); to obtain more accurate control of bank at large pitch angles; and to be able to fly—for the first time from a conventional artificial horizon—a given angle of climb or dive. The presentation also offers a facility for the assessment of pitch attitude during turns.

Although basically the same instrument as the Ferranti Type F.H.5 (Mk 4) standard artificial horizon is used, and the instruments are fully interchangeable, the new presentation features a two-colour,

Ferranti artificial horizon Type F.H.9.

half-inch-wide horizon bar divided horizontally into blue and green sectors. The lower, green (earth), sector has a series of divergent identification lines superimposed to assist in attitude recognition, and etched on to the glass face of the instrument are two pitch circles equivalent to pitch angles of 20 and 40 deg. Intermediate arcs governing pitch attitude only are marked for 10, 30 and 50 deg and markings on a roll scale show angles of roll of 10 and 20 deg. The instrument is hermetically sealed and incorporates the "pitchbank" method of turn error correction. The power requirements are nominally 115V, 400 c.p.s. three-phase A.C. with a starting power consumption of 75W, but the horizon can be operated from a stand-by D.C. supply through a transistor inverter control box.

The firm are also manufacturing a stand-by artificial horizon Type F.H.7 (Mk 1S) for use with a flight system or as a primary flight instrument. Conventional or "wide bar" presentation can be provided in a 3½in diameter S.A.E. case.

A radar system for the English Electric P.1B fighter has gone into production at the Edinburgh factory. The company is also actively developing high-speed electronic digital computers to operate as fast as any available.

Firth Cleveland Instruments, Ltd. A flowmeter to allow continuous and accurate presentations of the rate of fuel flow and total quantity of fuel consumed over the range of flows likely to be encountered in present-day and future aircraft is now being manufactured. The basic flowmeter installation comprises a unit fitted in the fuel pipe-line which generates an electrical signal, of a frequency proportional to the fuel flow rate. This is fed to a remote electronic integrator unit which, in turn, provides two output signals. These signals are passed to combined or separate indicators showing the rate of fuel flow and the total of fuel consumed.

Many variations of the installation are available, permitting the metering of single or dual fuel-flows in terms of mass or volumetric units. As the system is volumetric in principle, presentation in terms of mass requires correction for changes in fuel density. This is made available in either manual or automatic density correction forms. The latter effects a fully automatic and instantaneous correction, whereas the former must be set for fuel density before operation.

Two further types of control unit can be fitted to the system, which give a signal to operate a warning device or a control unit when a given level of flow rate is reached, or a definite quantity of fuel has been metered.

Flight Refuelling, Ltd. High speed refuelling of new airliners is one of the present concerns of this company. The Mk. 37 in-line refuelling/ defuelling valve has been developed for the purpose, and passes fuel at 240 Imp gal/min. Fuel-no-air valves are also being manufactured for use in air-pressurized feed systems. They cater for changes in pitch attitude of 90 deg and for a 60 deg roll angle. The float mechanism is counterbalanced against g effects.

A equal-flow valve has been developed to replace existing transfer valves and to save weight. The valves permit a pair of wing or drop tanks to be emptied symmetrically, by air pressure, into a central fuselage tank from which the engine feed is taken; they can be re-calibrated to cater for asymmetric systems and will maintain the equal flow under aerobatic conditions.

New components include a lightweight pipe connector FRS.525 and nozzles, valves and adaptors compatible with high test peroxide. A magnetic dipstick fuel level indicator has been developed for underwing tank contents gauging of the Comet and Vanguard without the risk of fuel spillage.

Sir George Godfrey and Partners, Ltd. The connections of this company with countries abroad has two functions: the establishment of companies in Australia, Canada and South Africa who are equipped to deal with the overhaul and after-sales service of British-made Godfrey equipment, and technical liaison and agreements with foreign firms for the manufacture of equipment of their design.

A good example of the latter arrangement is the development by Godfreys of screw compressors as cabin superchargers and compressors as the result of agreements with Svenska Rotor Maskiner of Sweden. The Godfrey/SRM positive displacement compressor Type 175 Mk 2 is designed to meet the air supply requirements of aircraft having large cabin volumes (it is to be used on the Vanguard) and to give high pressure ratios for pressurization at high altitudes. It is also used to supply air to air-cycle refrigerators.

A feature of this compressor is that it allows a proportion of the compressed air leaving the outlet to be returned to re-enter the compressor through a port in the bifurcated inlet manifold; this will increase the temperature of the pressurized air when required.

Another technical liaison agreement—with the Stratos division of the Fairchild Corporation—has resulted in the production of a range of valves and sensing units for the control of temperatures, pressures and flows in aircraft air-conditioning and refrigeration systems. Among these are the pneumatic temperature sensing unit PTSU-1, and temperature control valve PTCV-1. These units operate in conjunction; the temperature of air passing through the temperature sensing valve distorts a Bourdon tube and so operates a mechanism to throttle jets which are connected to the temperature control valve. A proportion of the air entering the latter is bled off into capsules controlled by the sensing unit. Consequent expansion or contraction of the capsules governs the setting of the valve admitting hot air to mix with the cold in the aircraft system.

To tackle the problem of cooling radar equipment, a new mark of specialized cooling equipment has been designed. This is the RCU-6 Dev.1, which employs both liquid and air coolants in a sealed package. In addition to cooling, the air is circulated through a pressurized canister in a closed cycle, and a Glycol-cooled heat exchanger is designed to reduce the temperature of a silicone coolant employed to dissipate the

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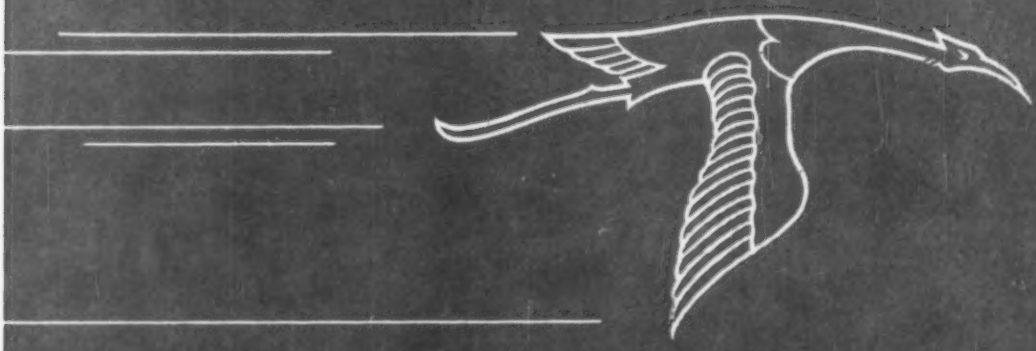

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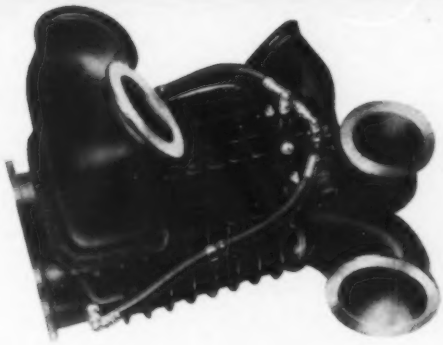


Godfrey/SRM Type 175 Mk 2 compressor.

ACCESSORY DEVELOPMENTS . . .

heat given off by the electronic apparatus.

Also in the line of pneumatic equipment in which the firm specializes is a new pneumatic actuator. Designated PA-15, it is a basic unit that can be used for a variety of purposes requiring a reversible rotary output actuator. Production of the well-known range of cold air units, cabin superchargers and water extractors continues. Godfrey is another concern that has turned its attentions to the G.W. field. As part of a system for supplying electricity and air to guided missiles, a connecting arrangement has been developed which enables cooling air, electrical power and signals to be delivered to a missile prior to launching.

Goodyear Tyre and Rubber Co., Ltd. In the twelve months that have passed since the aviation division of this company first displayed their tri-metallic brake, the design has gone into production for service on Viscount 800s. The division have also been responsible for developing the braking system, wheels and tyres for the Accountant. The brake is of the conventional cluster-pad type operating against a disc. Among other new aircraft for which the concern are supplying equipment are the Agricola, Rotodyne, Miles Aries and Student, DC-7C and EP.9.

Amongst the smaller items recently developed is a new master cylinder of the die-cast type (supplied for the Herald) and a relay-valve control box of the two-element type which provides for control by both pilot and co-pilot. Now installed at the division's headquarters at Wallasey is a new dynamometer.

H. M. Hobson, Ltd. Increasing use of A.C. electrical systems has created a growing demand for constant-speed alternator drives. The output speeds for constant frequency alternators must be very closely controlled; a new unit from Hobson maintains an 8,000 r.p.m. output shaft speed to within ±2 per cent. Over the full input speed range of 3,300 to 10,000 r.p.m. the output power is 10 kVA, and over a limited range of higher speeds it is 20 kVA. The Type 314 unit contains a

Hobson constant-speed drive Type 314.

variable-ratio hydraulic transmission featuring a fixed-displacement swashplate hydraulic unit on the input and a variable-displacement unit on the output, control governors, gearing and accessories.

The firm are continuing their development of electrically signalled flying controls, auto-stabilized and autopilot-integrated systems, feel simulators and fuel-control units. A new fuel-control unit is the Type 268 hybrid scheduling-speed governing system. It is of integrated construction, incorporating a gear type starting pump, main centrifugal pump with circulating impeller, flow control, accelerator control and speed governor.

Hymatic Engineering Co., Ltd. A new range of one-piece unit equipment connectors for all the personal services between pilot and aircraft is being produced by the Redditch concern. A single plug-in connector links all the oxygen and electrical services, but permits vacation of the seat automatically in an emergency jettisoning. For fighter applications and high altitude operation, models MSC.2b and MSC.6 are under development; these are based on exhaustive research and flight ejection trials. The special needs of bomber aircraft are met by the model MSC.3 connector for fixed seats, the MSC.4 for ejector seats and MSC.5 for transfer leads giving freedom of movement. An RV.51 relief valve is specified for use in conjunction with the personal connectors to safeguard the crew against excess breathing pressures; it also allows natural breathing after the emergency oxygen supply is exhausted.

Hymatic also manufacture a range of crew anti-g valves. The most recent models in this range are the AG.5 and AG.6, which are fed from tapped compressor air; they require no additional filters or pressure valves.

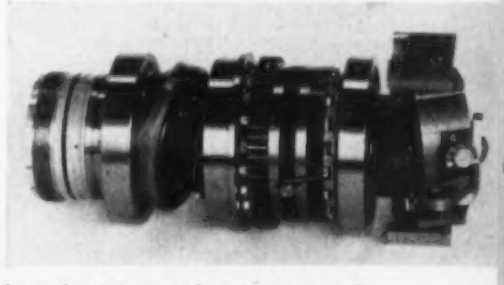
A range of hot-air pressure-reducing valves, including the PS.48 which accepts air at inlet temperatures of up to 300 deg C, and the PS.60 (mainly used for fuel system pressurization), will control an outlet pressure to within ±¼ lb/sq in for high rates of flow. These valves are also used for pressure reduction to air ventilated suits, when an FC.2 valve is used to control the flow. A new axial flow sleeve-type valve being developed for finer outlet pressure control is the PS.93, which incorporates integrated servo, compensating and stabilizing circuits. This valve is also suitable for higher temperatures up to 400 deg C and flows of over 430 cu ft/min.

This insistence upon fine control is regarded by Hymatic as the overriding essential, whether the valve is designed primarily for high temperature, high flow or high pressure. Further development of their PS.64 reducing valve (which is now well advanced towards H.T.P. compatibility) has made it suitable for inlet pressures of up to 4,500 lb/sq in. It will reduce to 7 lb/sq in at flows of 280 cu ft/min with a pressure tolerance of ±⅛ lb/sq in. The simplest valve in the range of over 100 different types is the PS.29, which, in its latest version, will control inlet pressures up to 2,000 lb/sq in. Although this particular valve incorporates a relief valve, it is not always possible to do so because of the high rates of flow if a reducing valve fails. A separate relief valve has consequently been developed to overcome this difficulty; it is the RV.37, which was designed on the results of simulated system-testing.

Other pneumatic components produced as the result of an expansion of development resources are mechanical and electrical snap bottles to provide packaged power for emergency operations, and integrated bottles and jacks to provide such packages in self-contained units. The firm are also concerned with high-temperature electro-pneumatic valves. The MD.30, 34 and 35 types are now in production and are fully type-tested to 3,000 lb/sq in and the high temperature MD.32 and MD.29 operate at 365 deg C and 400 deg C respectively.

Integral, Ltd. There have been a multiplicity of new developments from this well-known hydraulic-pump firm in the past twelve months. To meet the demand for lighter pumps capable of higher pressures and greater capacities installed in smaller spaces, Integral have developed the Type 234 and 236 axial-piston units giving infinitely variable delivery at a true constant pressure. Both pumps feature a fully automatic servo control which allows constant pressure and constant delivery to be maintained with a variable input speed or, by use of an alternative servo control, the pumps can be used with a normal hydraulic motor as a constant speed drive. The Type 236 pump weighs 10 lb, and delivers 0 to 10 gal/min at up to 4,000 r.p.m. and 0 to 15 gal/min at up to 6,000 r.p.m. The larger Type 234 delivers 0 to 22.5 gal/min at up to 6,000 r.p.m. and weighs 15 lb.

Another recent design for missile systems is the Type 231 high-speed ball-piston hydraulic pump. Running at as high a speed as possible permits size to be reduced for a given fluid flow. This pump operates at 24,000 r.p.m. (selected to coincide with a standard drive speed



Integral constant-speed motor pump unit Type 233.

for a 400 c.p.s. alternator) and at this speed delivers 9 cu in/sec. It is a short-life design weighing 1.5 lb and stressed for accelerations of 50 g.

A new motor pump unit is the Type 233 developed for the Hobson constant speed unit. An output speed of 8,000 r.p.m. is maintained between an input speed range of 3,000 to 10,000 r.p.m. The output power is up to 15 h.p. and the unit is used to drive a 15 kVA, 400 c.p.s. alternator.

Irving Air Chute of G.B., Ltd. Makers of parachutes and harness for a wide range of applications—the standard landing brake parachute assembly fitted to the Vulcan, emergency parachutes for Martin-Baker ejection seats and parachute recovery systems for Bristol and E.E. Co's missile projects—recent development from Irving has been directed towards improved detail design and the manufacture of a back-type parachute for gliders. The latter, known as the Type EB.50, is an

ACCESSORY DEVELOPMENTS . . .

inexpensive design to meet the requirements of civilian gliding clubs.

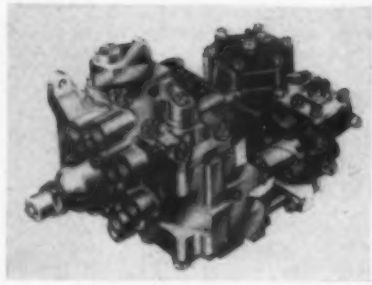
A new harness and lightweight flying overall is suitable for both static and moving crew members of an aircraft, and a new automatic parachute release Type BR/E is a purely mechanical instrument designed for reliability and simplicity in operation and maintenance. It can be stowed internally or externally.

Kelvin and Hughes (Aviation), Ltd. The most important development, and one which was achieved by the joint efforts of a number of companies, together with the M.o.S., R.A.E. and Institute of Aviation Medicine, is the Kelvin Hughes flight data system. It is, in effect, a brand new flight-instrument panel incorporating new presentations and functions designed for installation in jet fighters and other advanced aircraft. The system was fully described in *Flight*, August 16, 1957; its main feature is the linear—as opposed to dial—presentation of information obtained from an air data computer.

Other new products from this concern include a new audio incidence system, developed in collaboration with the M.o.S. from the airspeed sensing unit. By measuring the ratio between pressure sensed at the wing under-surface and total pitot head pressure, and transforming these into audio signals fed via the intercom to the pilot's earphones, the audio incidence system tells the pilot when his aircraft is in the correct approach condition. An alternative visual indicator with a scale marked degrees of angle of attack can be provided. The pressure senser and sound generator are housed together in a rectangular pressure-tight case weighing about 4½ lb.

The company has also developed the gyro-magnetic compass system Mk 5, designed specially for operation in conjunction with the S. G. Brown, Ltd., master reference gyro and the flight data system. It can also be supplied as a separate unit with its own 3¾in dial. Indicator, amplifier and detector together weigh approximately 16 lb, plus cables.

Joseph Lucas (G.T.E.), Ltd. The range of products manufactured by this major ancillary supplier includes fuel system and hydraulic equipment, combustion and other general engineering equipment. Under the last heading comes an air-operated hoist which, because it may be driven by tapped compressor air, is particularly suitable for gas turbine helicopters. It requires a maximum airflow of 0.066 lb/sec at 35 lb/sq in supplied from an external source and can lift up to 330 lb. It has a vertical hook travel of 100ft, a typical hoisting speed of 3ft/sec with a load of 220 lb, and weighs 24.5 lb.



Lucas combined control unit.

A remotely controlled shearing device can part the cable in an emergency, and a manual crank is provided. A feature of this equipment is that helicopter turbine air can be ducted around the unit to prevent ice formation.

Among the combustion equipment manufactured by Lucas is a fully variable propulsion nozzle of the "finger" type. Variations in nozzle area with reheat and with flight Mach number are controlled independently by means of rollers running in profiled slots in the fingers. These rollers are controlled by unison rings to which axial movement is given by screw jacks or by pneumatic means.

To assist in combustion-chamber design, the company has developed a flow-visualization rig in which water is pumped through a transparent model of the combustion chamber to simulate the airflow. Globules of polystyrene or air bubbles and a beam of light are used to illustrate the flow pattern in the various sections.

Martin-Baker Aircraft Co., Ltd. This company have two types of ejection seats in production; the standard service Mark 4 used by the Royal Air Force, Royal Navy and the airforces of foreign countries, and the Mark 5 which is supplied to the Grumman Aircraft Engineering Corporation. It is installed in the U.S. Navy Cougar. Both seats employ the patented barostatically controlled release mechanism, time-fired drogue gun and duplex drogue arrangement. After ejection the seat is under precise and timed control; first the drogue gun fires, extracting the leading controller drogue, which brings back the seat into a horizontal position and then tows the main drogue out of its stowage. This streams the parachute and lifts the occupant from the seat.

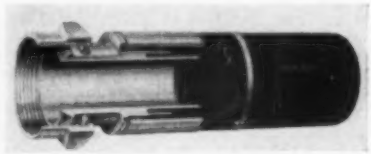
The firm are also responsible for explosive hood jettisoning equipment fitted to the Javelin, Hunter, Victor, Vulcan, Fiat G.91 and other new service aircraft.

Normalair, Ltd. During the year this company has put into production three new stainless-steel liquid-oxygen converters which are lighter than existing converters of comparable capacity. They have a working pressure of 300 lb/sq in, compared to 70 lb/sq in of existing equipment, and can therefore be used for recharging storage cylinders of portable oxygen sets.

In addition, Normalair are offering a new range of butterfly valves, consisting of a standard valve assembly in eleven bore sizes and either electric or pneumatic actuators. Standard mounting flanges allow interchangeability of valve assemblies and actuators. Shut-off, pressure control, flow control, pressure relief and temperature control valves, and differential pressure regulators, can be made up. A feature of these units is low torque at or very near the closed position. All units can be supplied in aluminium alloy or stainless steel.

Palmer Tyre, Ltd. An achievement of considerable merit by this company has been to develop a flexible hose unit to pass the Ministry of Supply's difficult D.T.D.3954 specification. Thanks to intensive development in special test rigs devised by Palmer, this the Silvoflex Type 200 high pressure hose did in May this year. It is now used extensively in the fuel control systems of many aircraft and guided missiles.

Other developments are pressure reducing valves and equipment for the non-destructive testing of aircraft components on site. This includes comprehensive mobile X-ray, Gamma-ray, fluorescent and magnetic facilities.



Palmer Silvoflex hose fitting.

Plannair, Ltd. A new development is a six-inch diameter single-stage axial flow blower powered by air either tapped from the engine or supplied by auxiliary aircraft compressors. It has been designed primarily for use in jet aircraft operating at high altitudes, and can be used for a variety of heating and cooling functions, although it is primarily intended to supply cooling air to electric and electronic apparatus. The new model (still in prototype form) differs from existing blowers—which operate subject to the load demand of the aircraft's electrical circuit—and gives greater control over mass air flow at varying altitudes. The design is also a radical departure from normal practice; the power unit consists of turbine blades and nozzles arranged around the periphery of the impeller.

Plannair have also developed a single-stage axial flow blower (which is coupled to a Rotol-designed gearbox) for Fairey's Rotodyne. These units serve the triple function of cooling oil, engine bay and electrical equipment, and one is installed in each engine nacelle, where it is driven by the engine.

Other axial flow blowers range in size

Lucas air-operated helicopter hoist.

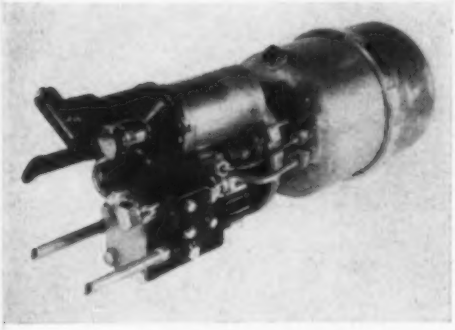
Martin-Baker Mk 5 ejection seat.

from one inch to 12in blade tip diameter. They vary in application from the cooling of radio and radar equipment to flight deck boost ventilation and cabin air recirculation. A specific cabin airflow application is for the 800 series Viscount.

The Plessey Co., Ltd. Becoming well-established as an ancillary manufacturer to the guided missile as well as to the aircraft industry, the Plessey Group of companies have developed a power pack for recharging servo-hydraulic accumulators. This is a turbine unit using iso-propyl-nitrate monofuel with combustion initiated by an electrically fired cartridge; the turbine drives a hydraulic pump through a reduction gearbox.

A fuel control valve is incorporated to vary fuel flow to the combustion chamber (and the power output of the turbine) with changes in hydraulic loading. The speed range is thereby governed to within five per cent, both on and off load. The power pack can be assembled into a missile and left in store in a safe condition. Provision is made for test running of the unit, using an external fuel supply, up to full hydraulic pressure with the unit charged with fuel. The specified power is 20 hydraulic h.p. at pressures up to 4,500 lb/sq in, and the dry weight is 16 lb.

A new development is a low voltage self-contained fluorescent lighting unit



Plessey iso-propyl power pack.

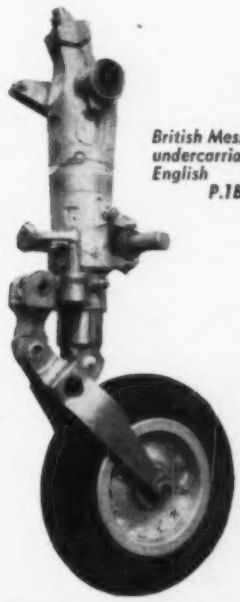
operating from a 24V D.C. supply. A vibrator oscillating at 200 c.p.s. converts the supply to A.C. and then transforms it to provide a suitable voltage for the lamp filaments and discharge currents. The 8-watt fluorescent tube is 14 mm in diameter and 12in long.

Rapid technical progress has been made in electronic and communication equipment. In this field are a "Castanet" Type A disc-type tantalum capacitor, embracing capacity values from 50 to 750 μF and with various mountings; radar-absorbing materials which eliminate undesirable permanent images from radar screens; and materials such as indium antimonide—a compound which is a sensitive detector of infra-red radiation. The last-named material is used as a single crystal filament in Plessey's infra-red cell Type PC21. This detector has a useful application in the spectroscopy field, in instruments for the detection and analysis of gases, and in pyrometry.

Other new products from the Plessey Group are a 3 kVA inverter similar to a type to be supplied for use in the Vanguard. The unit weighs less than 60 lb and, from a D.C. input supply between 25 and 29V, provides a three-phase output of 200V, 400 c.p.s. at any power factor between 0.8 lag and 0.95 lead. For small gas turbines a fuel-control unit is being developed. Operating at 4,000 r.p.m. and delivering fuel at 500 lb/sq in it will control turbine speed to ± 0.5 per cent and will give a 50 per cent change in fuel flow (up to a maximum of 25 gal/hr) for a one per cent speed change.

The Pyrene Co., Ltd. The latest item in this company's range of fire-fighting and crash-protection equipment is the impact crash switch, Type PCS/1. It consists of a lever projecting underneath the belly of the aircraft which, on striking the ground, breaks a cathodeon frangible switch and initiates the electrical crash circuit. To avoid false alarms from bird strikes in mid-air the tripping of the lever produces another lever in its place, and it is the deflection of this second lever which actually initiates the crash circuit; thus a single strike in mid air would move only the first lever, but solid impact with the ground would, of course, trip both. Pilot-operated switches are provided to arm, de-arm or test this device. The complete switch can be mounted flush with the aircraft skin and connected to the crash circuit with a single four-pin plug.

Rotol and British Messier, Ltd. Rotol, Ltd., are responsible for the design of the propellers for the F.27 Friendship. They are similar to those on the Viscount, but are two feet greater in diameter and the blade bearings are slightly larger. The propeller operates from a starting pitch angle of 0 deg to the feathered angle of



British Messier nose undercarriage for English Electric P.1B.

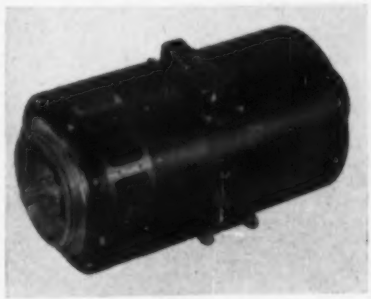
approximately 84 deg. The blade leading edges, the spinner nose and the engine air intake are electrically de-iced.

Also for the F.27 is the automatic r.p.m. synchronizing equipment. A small three-phase alternator is fitted to each engine; one of which is selected as the master. A further small connector motor is incorporated in the control system of the slave engine. A switch in the cockpit gives on-off control and, in operation, automatically adjusts the r.p.m. of the slave engine to that of the master. This equipment can be adapted to four-engined aircraft.

Production of bleed air turbine and fuel flow proportioning equipment continues. The latter equipment has lately been modified by the addition of hydraulic power to drive the proportioning valves. The unit no longer takes power from the fuel line, but can impart a pressure rise as the fuel passes through its cells.

Apart from manufacturing the P.1, Britannia and Gnat undercarriages, British Messier have developed their 4,000 p.s.i. motor pump unit 4873—among a wide range of hydraulic equipment—for long periods of operation. Special features are glass and silicone insulation.

Rotax, Ltd. Continuing their development of variable-speed, constant-frequency alternators (to supplement their widely-used D.C. generating equipment), Rotax have produced the new 80 kVA unit



Rotax 80 kVA variable-speed alternator.

shown in the photograph. Rectified A.C. schemes have been designed for outputs of up to 900 amp, 112V D.C. and 400 amp, 28V D.C. Rotax alternators running at constant speeds of 8,000 r.p.m. and 24,000 r.p.m. give outputs of 0.5 kVA to 130 kVA and 15 kVA to 55 kVA respectively.

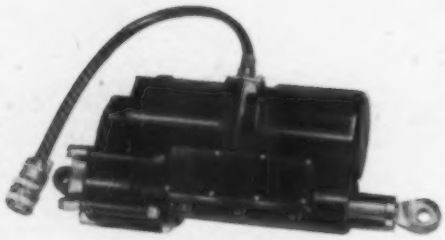
The company claim that every British gas turbine engine has been started with Rotax electrical starters, of which 28V D.C., 112V D.C., and 208V three-phase A.C. types are manufactured. Engine starting is one of Rotax's special interests; they have also developed cordite, fuel/air and low pressure air starting systems, including the new 5712/1 pneumatic unit.

Among the range of electrical equipment developed is a wide range of rotary and linear actuators, motors, inverters and control panels. The latest versions of the last-named utilize magnetic amplifiers and can maintain an almost constant output voltage and frequency irrespective of wide variations in load and input voltage.

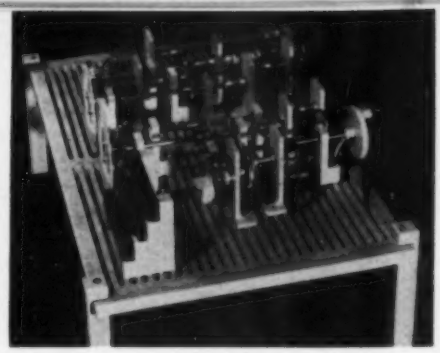
Saunders Valve Co., Ltd. Really efficient valves are Saunders' concern. They have, it is claimed, now realized 100 per cent efficiency in their spherical

Saunders motorized spherical plug valve.

two-way plug, and 95 per cent in a "Y"-ported multi-way type. These valves meet British and American specification requirements and are supplied in manually and electrically operated forms. A



(Left) Western Mfg. (Reading) 4,500 actuator for Fiat.



(Right) Vactric "breadboard" servo layout.

ACCESSORY DEVELOPMENTS . . .

new model this year is a flap type non-return valve. It is light, requires a very low head of fluid to crack it, and is claimed to give a flow efficiency of about 95 per cent.

The company are also manufacturing a range of taps and valves for aircraft domestic water and beverage control, produced in various finishes to suit interior decoration schemes.

Short Bros. and Harland, Ltd. Apart from the manufacture of complete aircraft, Short's specialist knowledge is used in the production of a growing range of aircraft and development equipment. Becoming well known is the analogue computor. It is a compact electronic instrument, intended both for the solution of differential equations and the simulation of actual physical systems. It has been designed for quantity production and a "substantial number" of these instruments are already in operation.

A bank of three analogue computors is linked to a flight simulator, equipped with normal controls and instruments, to enable the aerodynamic behaviour of an intended design to be assessed. The computors record all control movements and feed the results back into the cockpit instruments; the characteristics of the aircraft can be modified by adjusting the settings of the computor dials until the desired response is obtained.

A recent structural innovation from the company is the "floating floor" and freight lift designed for the Britannia 253. This was described in *Flight* August 9, 1957. Short's Precision Engineering Division have recently designed an electro-mechanical release to overcome a deficiency in the use of a standard bomb slip as a brake parachute release—a sensitivity to shock loadings causing premature release. The new unit is enclosed in a light alloy case, and incorporates the standard type of jaw. A 24-V D.C. torque motor with a balanced rotor actuates the release, and provision is made for indicating correct cocking by means of connections which may be taken to a cockpit lamp. Manual release is provided by a push button and cocking is automatic on loading. When the unit is used as a brake parachute release a special housing with a "coning" load attachment is provided. A range of sizes is manufactured; the smallest has a 5,000 lb operation load.

Smiths Aircraft Instruments, Ltd. Added to the well-known long-scale jet-pipe temperature indicators made by this company is a new servo system, the outstanding feature of which is a new dial presentation. Any selected 300-deg band between zero and 1,000 deg may be expanded to occupy 180 deg of scale arc. The closed-up scales for temperatures either side of the selected 300 deg remain. The advantage of this system is that an important range of jet-pipe temperatures can be more exactly read on an expanded scale without increasing the overall size of the indicator. The weight of the complete system has been carefully controlled and an installation for a multi-engine aircraft is lighter than that of earlier plain gauges.

The Sperry Gyroscope Co., Ltd. Twelve months ago, the appearance of the company's integrated flying-control system was greeted with considerable interest. Sperry are able to offer themselves as main contractors for the full design and manufacture of similar complete integrated control and instrument systems, including powered controls, autopilots, autostabilizers, pilot's instruments and associated reference systems. They have developed a roller blind attitude-indicator, a precision r.p.m. indicator system suitable for helicopter rotor applications, and various synchro units and miniature servo components.

Sperry are also studying various applications of Vickers (U.S.A.) hydraulic pumps, which they are to build under licence as a component in comprehensive hydraulic systems. Among these are undercarriage wheel drives and brakes for aircraft "engine-off" taxying, constant-speed alternator drives, engine starting systems, and the operation of hatches and main entrance doors. These ground-service applications are interesting, as they pre-suppose that the aircraft is equipped with an auxiliary power unit to drive the hydraulic pump and energize all the services; ground servicing equipment to fulfil these functions would not be required.

Increased national emphasis on guided weapons is reflected in the growing interest in G.W. control-system components. Sperry have recently produced a range of mechanical, hydraulic and electronic units, including an electro/hydraulic relay unit and an accelerometer.

Teddington Aircraft Controls, Ltd. The two main factors governing ice formation on aircraft are the temperature of the vulnerable surfaces and the moisture content of the surrounding atmosphere. Equipment for measuring the latter parameter is being developed and manufactured by this company. A moisture-content head measures the free-water concentration in the airstream on the principle of the differential cooling effect of two heated cylinders, one in the airstream and the other so housed that no moisture impinges upon it. The temperature differential is used as a resistance difference in a Wheatstone bridge circuit to provide an out-of-balance current that is a function of the free-water concentration. The moisture content indicator is a panel-mounted milliameter.

A large part of Teddington's development programme has been devoted to the design of pneumatic pressure regulators for relatively large airflows at high operating and ambient temperatures; a representative unit for this job is the Type FPU/A/2 pressure regulator designed to maintain an outlet pressure of 35 lb/sq in with a 5 lb/sq in tolerance at inlet pressures of 35 to 200 lb/sq in. The valve is capable of handling air at 350 deg C in ambient temperatures of −40 deg C to 250 deg C. It comprises a piston-type valve operated by a capsule-regulated vent from the rear of the piston, downstream pressure being sensed from the inside of the capsule. A pre-determined minimum flow at reduced pressure—a particular requirement of gas turbine intake de-icing systems—is available if the capsule fails.

A new double butterfly valve Type FOM pressure switch, and carbon plug valves are among the wide range of valves and controllers which the company has further developed during the past twelve months.

Vactric (Control Equipment), Ltd. A telemetry switch finding increasing application is the Vactric TDX204, which in the course of a missile flight of say 15 minutes can sample approximately 35,000 separate items of information. It comprises a P200 D.C. servo motor, a precision servo gearhead and a bank of wafer switches which combine together to form a reliable compact unit.

The firm have also introduced a scheme of "breadboard" servo components. These, rather like a set of building blocks, enable the servo designer to fabricate his prototype quickly without expensive, specially machined assemblies.

Vactric claim to be the only manufacturers of precision servo gearheads in Great Britain and can now offer them in a wide variety of frame sizes for servo motor needs. Until their introduction all servo gear requirements had to be satisfied by the use of open gearing. These designs are now superseded by enclosed and lubricated types which meet the relevant M.o.S. specifications. They are also made as speed reducers. In this form they have two shaft extensions, one to the motor, the other to the drive.

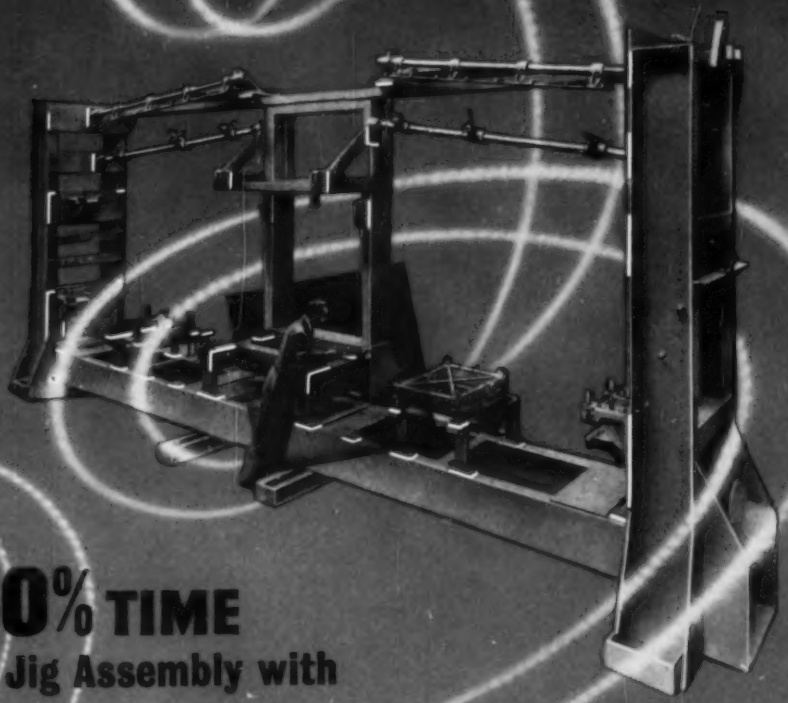
A new development is a range of A.C. components which includes servo motors, damped servo motors, motor generators, tacho-generators, synchronous motors and magnetically braked versions.

Western Manufacturing (Reading), Ltd. Continuing with their wide range of aircraft accessories—including switches and fractional h.p. motors—this company have recently added a new actuator to their list of universal linear and rotary types. This is the EOJ 123 Mk 1 universal linear offset type, in which the gear cluster can be positioned and repositioned in a number of different ways to give variations in operation load. The range of universal actuators covers types with maximum operating loads of 30 lb to 150 lb. For a special application, the concern have developed the EOJ 4,500 actuator, which is claimed as one of the largest of its kind in general use. It has a maximum output of 6,000 lb, working load of 4,500 lb, stroke of 4.0in (in ten secs) and weighs 23 lb.

This company have developed, among their range of switchgear—including trim switches, rotary switches and limit switches—a fuel jettison switch for the Blackburn Aircraft Co. A small accessory is Type CCV. 131 stall warning indicator, and this range of miniature components includes a relay mechanism, terminal blocks, hydraulic power valves and thermostats. Some of the latter components have a missile application, controlling a butterfly valve.

A new departure for Western is the development of an automatic dynamic test rig for inspection of the output of automatic production machines.

JIGS
- in Double Quick Time !



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A. V. ROE & Co. Ltd., to whom we are indebted for this information, consider that no return to the old methods could be entertained, as the cost would be absolutely prohibitive.

Full details sent on request

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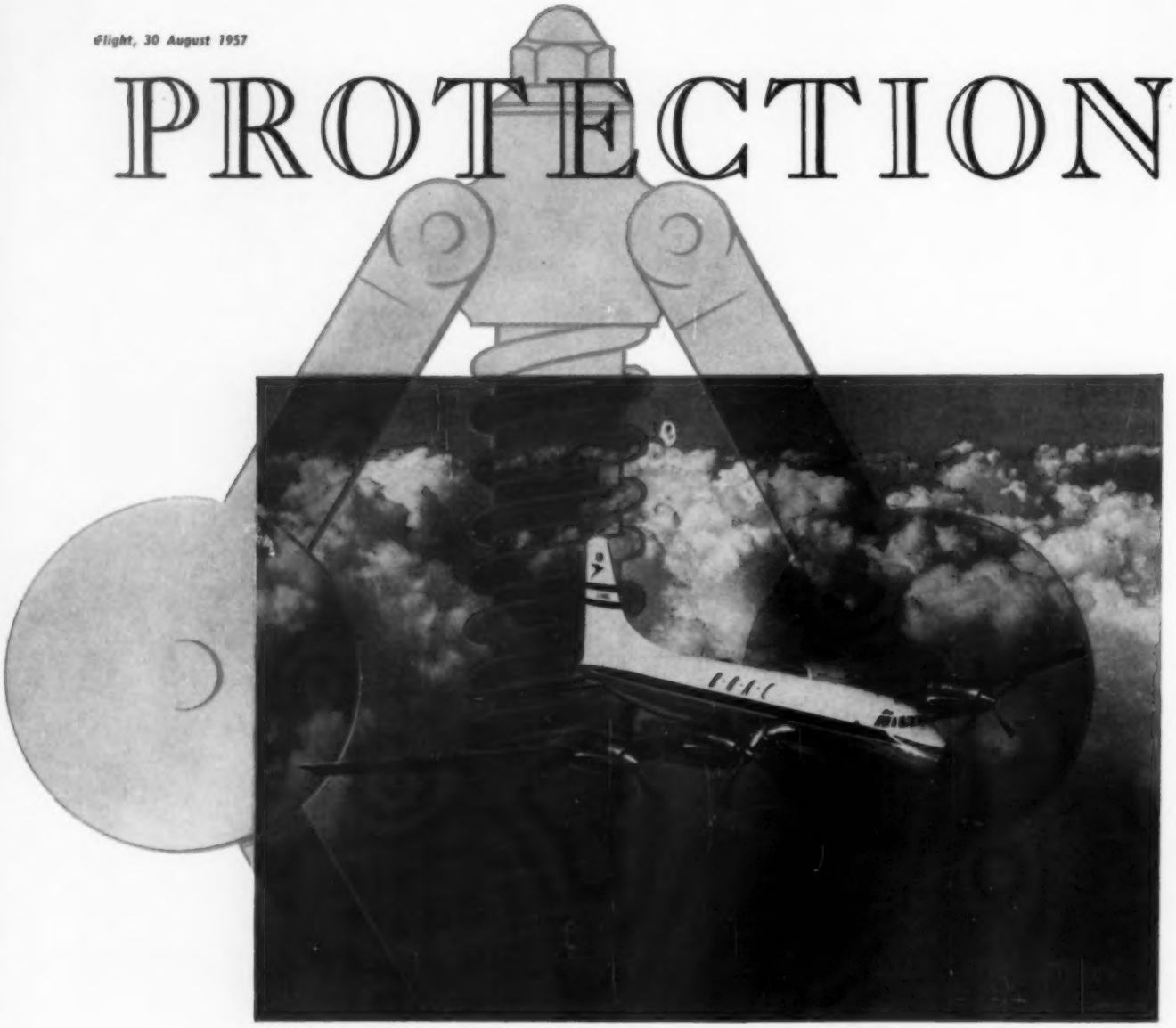

Iso-Speedic safety equipment is extensively used for the accurate control of speed and for the overspeed protective circuits of turboprops.

The illustration shows the Bristol 'Britannia,' fitted with Iso-Speedic speed-conscious electric switches

Iso-Speedic

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The Ancillary Industry

"FLIGHT" READY-REFERENCE DIRECTORY TO PRODUCTS AND FIRMS

IN this special directory section of "Flight" over 350 components, accessories, services, etc., are listed in quick-reference form, and under the headings are the names of over 500 United Kingdom firms whom we understand to be manufacturers or suppliers of such items. Their addresses, with telephone numbers and telegraphic registrations, are given alphabetically at the end of the products directory. Aircraft and engines are dealt with in detail in the special reviews earlier in this issue, as are new developments in certain classes of major equipment. Air-transport operations are not included; they have their place in our annual Civil Aviation Number.

ADDRESSES: PAGES 363-368

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Minnesota Mining and Manufacturing Co., Ltd.
Morris, Ltd., B. O.
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Parman Aircraft Supplies, Ltd.
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Lea Bridge Industries, Ltd.
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Miles, Ltd., F. G.
Murphy Radio, Ltd.
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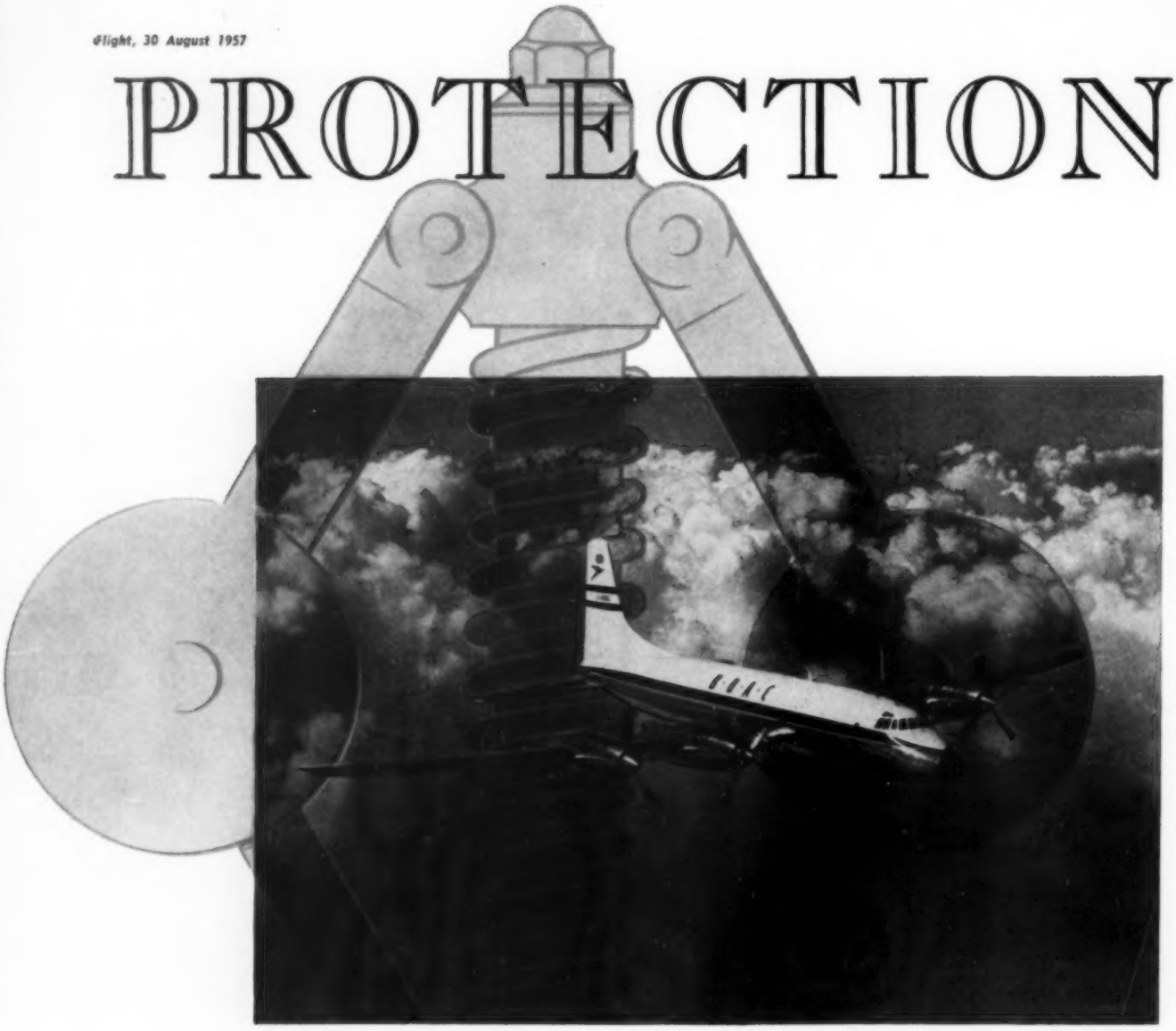

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Field Aircraft Services, Ltd.
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
McMichael Radio, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Miles, Ltd., F. G.
Murphy Radio, Ltd.
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Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
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Derby Aviation, Ltd.
Dundas, Ltd., R. K.
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British Manufactured Bearings Co., Ltd.
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Delaney Gallay, Ltd.
Dragonair, Ltd.
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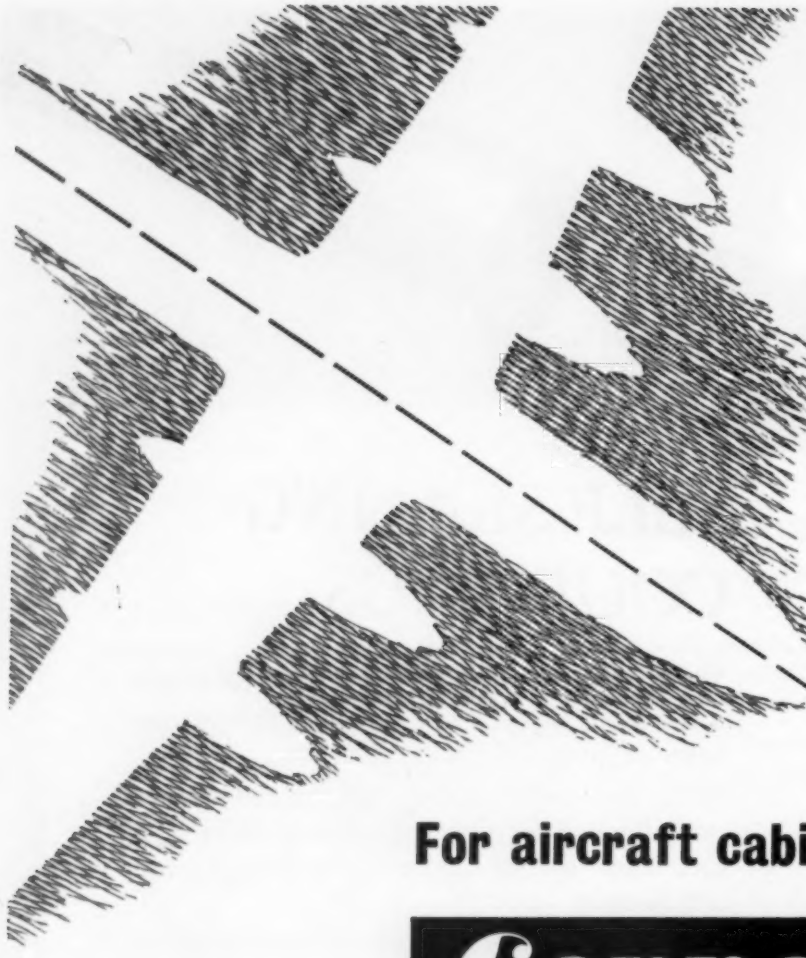

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British Thomson-Houston Co., Ltd.
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C.J.C. Developments (Portsmouth), Ltd.
D. and P. Tools
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
Helliwells, Ltd.
Jig Design and Engineering Co.
Lancefield Aircraft Components, Ltd.
Lion Electronic Developments, Ltd.
McInnes, Ltd., Dobbie
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
M. L. Aviation Co., Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Muirhead and Co., Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Pipework and Engineering (Bristol), Ltd.
Plessey Co., Ltd., The
Precision Rubbers, Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Sheffield Smelting Co., Ltd., The
Solartron Electronic Group, Ltd., The
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tecalemit, Ltd.
Technograph Printed Circuits, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Whittemore (Aeradio), Ltd., A. J.

COMPONENTS, ENGINE, GENERAL
Aerocontacts (Aircraft Distributors), Ltd.
Avica Equipment, Ltd.
Avimo, Ltd.
Birkett, Billington and Newton, Ltd.
Blocktube Controls, Ltd.
Brown Brothers (Aircraft), Ltd.
Campbell (Engineers), Ltd., J. R.
Curd Components, Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
E.N.V. Engineering Co., Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Hughes Engineering Co. (Leicester), Ltd.
Jig Design and Engineering Co.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Laycock Engineering, Ltd.
Leytonstone Jig and Tool Co., The
Lucas (Gas Turbine Equipment), Ltd., Joseph.
M.H.H. Engineering Co., Ltd.
Motor Components (Birmingham), Ltd.
Newton and Co., H. T.
Oil Feed Engineering Co., Ltd.
Opperman, Ltd., S. E.
Parman Aircraft Supplies, Ltd.
Pipework and Engineering (Bristol), Ltd.
Reilly Engineering, Ltd.
Skyways, Ltd.
Talbot Stead Tube Co., Ltd.
Telehoist, Ltd.
Turner Manufacturing Co., Ltd.
V.P. Sheet Metal, Ltd.
Weyburn Engineering Co., Ltd.
Woodside Die Sinking Co., Ltd.
Yorkshire Engineering Supplies, Ltd.
Y.S.C., Ltd., The

COMPONENTS, GAS-TURBINE SHEET METAL
Airflow Streamlines, Ltd.
Aviation Traders (Engineering), Ltd.
Briggs Motor Bodies, Ltd.
British Refrasil Co., Ltd., The
Burnley Aircraft Products, Ltd.
Clifford Products, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Field Aircraft Services, Ltd.
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Pipework and Engineering (Bristol), Ltd.
Sankey and Sons, Ltd., Joseph
V.P. Sheet Metal, Ltd.

COMPRESSORS, INDUSTRIAL
Aerocontacts (Ground Equipment), Ltd.
British Brown-Boveri, Ltd.
British Thomson-Houston Co., Ltd.
Godfrey and Partners, Ltd., Sir George
Hymatic Engineering Co., Ltd., The
Newton and Co., H. T.
Rover Gas Turbines, Ltd.
Wakefield and Co., Ltd., C. C.
Wakefield-Dick Industrial Oils, Ltd.
Williams and James (Engineers), Ltd.

COMPUTERS, ELECTRONIC
Air Trainers Link, Ltd.
Brown, Ltd., S. G.
Decca Radar, Ltd.
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Fairey Aviation Co., Ltd., The
General Electric Co., Ltd., The
McInnes, Ltd., Dobbie
Miles, Ltd., F. G.
M.L. Aviation Co., Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Saunders-Roe, Ltd.
Solarton Electronic Group
Southern Instruments, Ltd.
Standard Telephones and Cables, Ltd.

Lewin runway sweeper (Brockhouse and Co., Ltd.).

THE ANCILLARY INDUSTRY . . .

CONNECTORS, ELECTRICAL
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Brown Brothers (Aircraft), Ltd.
C.W.C. Equipment, Ltd.
Eagle Aircraft Services, Ltd.
E.R.S. (London), Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
Henley's Telegraph Works Co., Ltd., W. T.
Lion Electronic Developments, Ltd.
M.H.H. Engineering Co., Ltd.
M.L. Aviation Co., Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pye, Ltd.
Reliance Electrical Wire Co., Ltd., The
Scottish Distributors, Ltd.
Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vosper, Ltd.
W.S. Electronics (Production), Ltd.
Waymouth Gauges and Instruments, Ltd.
Whittemore (Aeradio), Ltd., A. J.

CONNECTORS, HOSE
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Air Service Training, Ltd.
Automotive Products Co., Ltd.
Avica Equipment, Ltd.
Avimo, Ltd.
Bell's Asbestos and Engineering, Ltd.
British Oxygen Engineering, Ltd.
Brown Brothers (Aircraft), Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hymatic Engineering Co., Ltd., The
King Aircraft Corporation
Newton and Co., H. T.
Oil Feed Engineering Co., Ltd.
Palmer Tyre, Ltd., The
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Stewart Aeronautical Supply Co., Ltd.

CONSULTANT SERVICES
Airwork, Ltd.
Aviation and Engineering Projects, Ltd.
Baynes Aircraft Interiors, Ltd.
Dart Aircraft, Ltd.
Derby Aviation, Ltd.
Dundas, Ltd., R. K.
E.P.S. (Research and Development), Ltd.
International Aeradio, Ltd.
Kent Alloys, Ltd.
Miles, Ltd., F. G.
Newton and Co., H. T.
Power Jets (Research and Development), Ltd.
Precision Rubbers, Ltd.
Rollason Aerocessories, Ltd.
Skylines Aircraft Components, Ltd.
Sutton (Consultants), Ltd., R. W.
Whittemore (Aeradio), Ltd., A. J.

CONTROLS, ENGINE
Bloctube Controls, Ltd.
British Wire Products, Ltd.
Dowty Fuel Systems, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Rotax, Ltd.
Rotol, Ltd.
Skylines Aircraft Components, Ltd.
Teleflex Products, Ltd.
Telehoist, Ltd.
Ultra Electric, Ltd.
Venner, Ltd.

CONTROLS, FLYING
Aero Controls, Ltd.
Automotive Products Co., Ltd.
British Messier, Ltd.
British Wire Products, Ltd.
Brown, Ltd., S. G.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Elliott Brothers (London), Ltd.
Field Aircraft Services, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd., The
Newton and Co., H. T.
Opperman, Ltd., S. E.
Parman Aircraft Supplies, Ltd.
Rotax, Ltd.
Skylines Aircraft Components, Ltd.
Teleflex Products, Ltd.
Telehoist, Ltd.
Wilmot Breeden, Ltd.

CONTROLS, POWERED
Automotive Products Co., Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Parman Aircraft Supplies, Ltd.
Sperry Gyroscope Co., Ltd.

COPPER
Aircraft Materials, Ltd.
Birkett, Billington and Newton, Ltd.
Booth and Co., Ltd., James
British Insulated Callender's Cables, Ltd.
Eagle Aircraft Services, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Rollet and Co., Ltd., H.

CORROSION INHIBITORS AND EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Brand and Co., Ltd., R. A.
Brent Chemical Products, Ltd.
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd.
Field Aircraft Services, Ltd.
Kenilworth Manufacturing Co., Ltd.
Peradin and Watercraft, Ltd.
Pyrene Co., Ltd., The
Shell-Mex and B.P., Ltd.
Skyhi, Ltd.
Wakefield and Co., Ltd., C. C.
Wakefield-Dick Industrial Oils, Ltd.
Walterisation Co., Ltd., The

COUNTING EQUIPMENT
Ferranti (Meters), Ltd., Denis
Racal Engineering, Ltd.
Reilly Engineering, Ltd.
Sanders (Electronics), Ltd., W. H.

COUPLINGS, FLEXIBLE (see also Joints, Universal)
Aero Controls, Ltd.
Automotive Products Co., Ltd.
Avery-Hardoll, Ltd.
Avica Equipment, Ltd.
Bell's Asbestos and Engineering, Ltd.
Brown Brothers (Aircraft), Ltd.
Clayton-Wright, Ltd., Howard
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hardy Spicer, Ltd.
High-Pressure Components, Ltd.
I.V. Pressure Controllers, Ltd.
King Aircraft Corporation
Laycock Engineering, Ltd.
Mollart Engineering Co., Ltd., The
Oil Feed Engineering Co., Ltd.
Parman Aircraft Supplies, Ltd.
Peradin and Watercraft, Ltd.
Power Auxiliaries, Ltd.
Silentbloc, Ltd.
Spencer Moulton and Co., Ltd., George

COVERS, AIRCRAFT, ETC.
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Clapham Park Motors, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
Rumbold and Co., Ltd., L. A.

DAMPERS, CONTROL
Pullin and Co., Ltd., R. B.
Westminster Airways Servicing, Ltd.

DECARBONIZING PREPARATIONS AND EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Bennett (Hyde), Ltd.
Brent Chemical Products, Ltd.
Morris, Ltd., B. O.

DEGREASING PREPARATIONS AND EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Bennett (Hyde), Ltd.
Brent Chemical Products, Ltd.
Docker Brothers
Eagle Aircraft Services, Ltd.
Laycock Engineering, Ltd.
Pyrene Co., Ltd., The
Shell-Mex and B.P., Ltd.
Valay Industries, Ltd.
Walterisation Co., Ltd., The

DE-ICING AND ANTI-ICING EQUIPMENT AND FLUIDS, ETC.
Aerocontacts (Ground Equipment), Ltd.
Avica Equipment, Ltd.
B.P. Aviation Service
Baxter, Woodhouse and Taylor, Ltd.
Bell's Asbestos and Engineering, Ltd.
Dragonair, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd.
French and Sons, Ltd., Thomas
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Kilfrost, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Manchester Oil Refinery (Sales), Ltd.
Miles Structural Plastics, Ltd.
Napier and Son, Ltd., D.
Palmer Tyre, Ltd., The
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Rotol, Ltd.
Serck Radiators, Ltd.
Shell-Mex and B.P., Ltd.
Skylines Aircraft Components, Ltd.
Stewart Aeronautical Supply Co., Ltd.
T.K.S. (Aircraft De-Icing), Ltd.
Technograph Printed Circuits, Ltd.
Teddington Aircraft Controls, Ltd.
Triplex Safety Glass Co., Ltd.
Wilmot Breeden, Ltd.

DESIGN AND EXPERIMENTAL WORK
(see also Drawing Office Services)
Aircraft Materials, Ltd.
Air Service Training, Ltd.
Airwork, Ltd.
Appleby and Ireland, Ltd.
Aviation and Engineering Projects, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Boulton Paul Aircraft, Ltd.
Bretts Precision Engineering Co., Ltd.
British Aviation Services (Engineering), Ltd.
Brookland Aviation, Ltd.
C.J.C. Developments (Portsmouth), Ltd.
Cornercroft, Ltd.
D. and P. Tools
Delaney Gallay, Ltd.
E.P.S. (Research and Development), Ltd.
English Electric Co., Ltd.
Fairey Aviation Co., Ltd., The
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Flint, Ltd., Howard
Graseby Instruments, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd.
Heston Aircraft and Associated Engineers, Ltd.
Irving Air Chute of Great Britain, Ltd.
Irwin and Partners, Ltd., B. G.
Jet Tanks
Jig Design and Engineering Co.
King Aircraft Corporation
Light Engineering Designs (Gosport), Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Lusifell Products, Ltd.
Mechanism, Ltd.
Mercury Truck and Tractor Co., Ltd., The
Miles, Ltd., F. G.
Miles Structural Plastics, Ltd.
Morfax, Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
North West Machine Design Co., Ltd.
Opperman, Ltd., S. E.
Pipework and Engineering (Bristol), Ltd.
Plessey Co., Ltd., The
Portsmouth Aviation, Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Skyways, Ltd.
Telehoist, Ltd.
Test Equipment, Ltd.
Thermo-Plastics, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Tropical Preservation Co., Ltd.
W.S. Electronics (Production), Ltd.
Wakefield and Co., Ltd., C. C.
Western Manufacturing (Reading), Ltd.
Williamson Manufacturing Co., Ltd.
Woodside Die Sinking Co., Ltd.

DIALS, INSTRUMENT
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Metal Gravure Co., Ltd., The
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Pullin and Co., Ltd., R. B.
Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.

DIAPHRAGMS
Appleby and Ireland, Ltd.
Dunlop Rubber Co., Ltd
Field Aircraft Services, Ltd.
Hall and Hall, Ltd.
Kelvin and Hughes, Ltd.
Long and Hambly, Ltd.
Mechanism, Ltd.
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.
Newton and Co., H. T.
Precision Rubbers, Ltd.
Skylines Aircraft Components, Ltd.
Spencer Moulton and Co., Ltd., George
Trist and Co., Ltd., Ronald
Whittemore (Aeradio), Ltd., A. J.

DINGHIES
Aerocontacts (Sales), Ltd.
Dart Aircraft, Ltd.
Elliot Equipment, Ltd.
Frankenstein and Sons (Manchester), Ltd., P.
Jablo Plastics Industries, Ltd.
Lea Bridge Industries, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
R.F.D. Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

DOCKS, AIRCRAFT MAINTENANCE
Access Equipment, Ltd.
Aerocontacts (Ground Equipment), Ltd.
Hawksley S.M.D., Ltd.
Heston Aircraft and Associated Engineers, Ltd.
Mercury Truck and Tractor Co., Ltd.
Morfax, Ltd.
Ross, Ltd., S. Grahame

DOORS (FOLDING, SLIDING, Etc.), AND SHUTTERS
Bolton Gate Co., Ltd.
Esavian, Ltd.
Hawksley S.M.D., Ltd.
Lancefield Aircraft Components, Ltd.

DOPES.—see Finishes

DRAWING OFFICE EQUIPMENT
Aviation and Engineering Projects, Ltd.
Skylines Aircraft Components, Ltd.

DRAWING OFFICE SERVICES (see also Design and Experimental Work)
Air Service Training, Ltd.
Airwork, Ltd.
Appleby and Ireland, Ltd.
Aviation and Engineering Projects, Ltd.
Aviation Traders (Engineering), Ltd.
Avimo, Ltd.
Baynes Aircraft Interiors, Ltd.
British Aviation Services (Engineering), Ltd.
Brooklands Aviation, Ltd.
Burnley Aircraft Products, Ltd.
E.P.S. (Research and Development), Ltd.
Fairey Aviation Co., Ltd., The
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Helliwells, Ltd.

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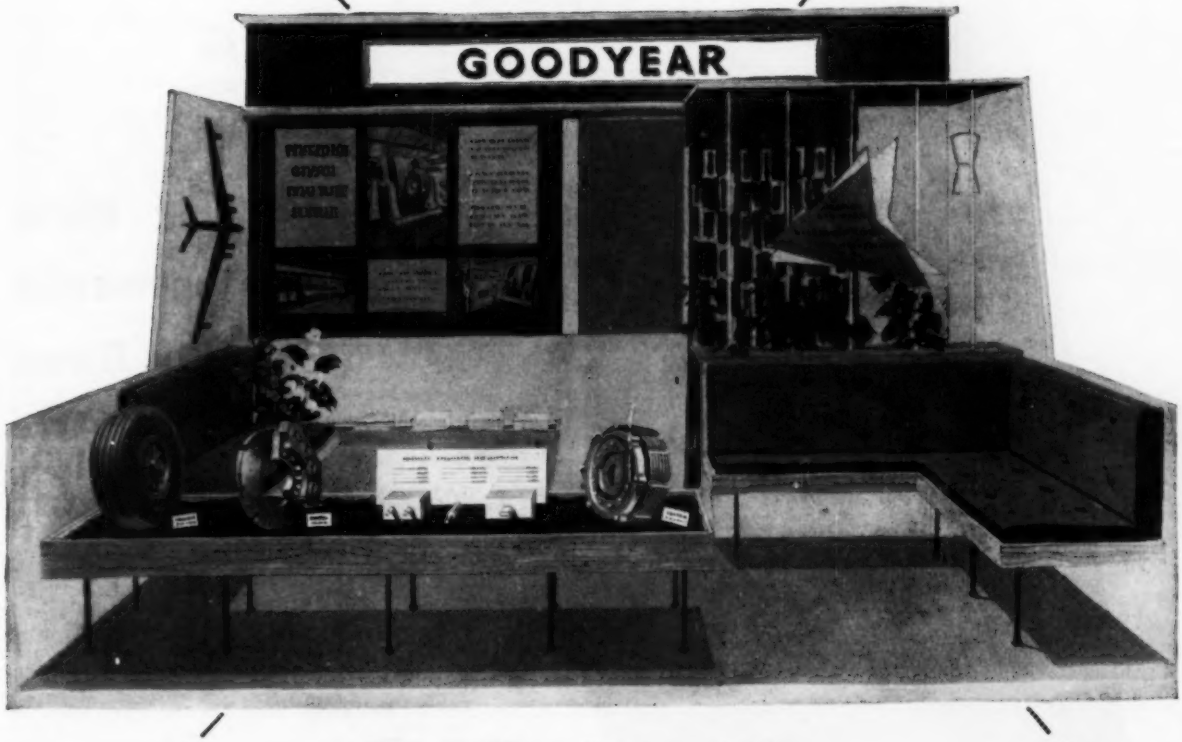
ADDRESSES OF COMPANIES: pages 363-368

SAY '99'



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THE ANCILLARY INDUSTRY...

Drawing Office Services (cont.)

Heston Aircraft and Associated Engineers, Ltd.
Irwin and Partners, Ltd., E. G.
Jig Design and Engineering Co.
King Aircraft Corporation
Kodak, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Light Engineering Designs (Gosport), Ltd.
Lusifell Products, Ltd.
Mercury Truck and Tractor Co., Ltd.
Miles, Ltd., F. G.
Morfax, Ltd.
North West Machine Design Co., Ltd.
Portsmouth Aviation, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Samiesbury Engineering, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Skyways, Ltd.
T.E. Tools, Ltd.
Telehoist, Ltd.
Test Equipment, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Western Mfg. (Reading), Ltd.

EAR DEFENDERS

Anticoustic Co., The
Ferranti (Meters), Ltd., Denis
Long and Hambly, Ltd.
Mallock-Armstrong Co., The
Siebe, Gorman and Co., Ltd.
Sutton (Consultants), Ltd., R. W.

EDUCATION, TECHNICAL (other than apprenticeships)

Air Service Training, Ltd.
Miles, Ltd., F. G.
Power Jets (Research and Development), Ltd.

ELECTRICAL EQUIPMENT, GENERAL

Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Avica Equipment, Ltd.
Avimo, Ltd.
Bretts Precision Engineering Co., Ltd.
British Thomson-Houston Co., Ltd., The
Brown Brothers (Aircraft), Ltd.
E. R. S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Helliwells, Ltd.
Light Engineering Designs (Gosport), Ltd.
McInnes, Ltd., Dobbie
McMichael Radio, Ltd.
M. L. Aviation Co., Ltd.
Measuring Instruments (Pullin), Ltd.
Muirhead and Co., Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Portsmouth Aviation, Ltd.
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Scottish Distributors, Ltd.
Skylines Aircraft Components, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Stone and Co. (Deptford), Ltd., J.
Telegraph Construction and Maintenance Co., Ltd., The
Vactric (Control Equipment), Ltd.
Vosper, Ltd.
W.S. Electronics (Production), Ltd.
Western Mfg. (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wynn and Co. (Aircraft), Ltd., E. D.

ELECTRONIC EQUIPMENT, GENERAL (see also Components and Details, Electronic)

Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Air Trainers, Ltd.
Anticoustic Co., The
Appleby and Ireland, Ltd.
Avimo, Ltd.
Boulton Paul Aircraft, Ltd.
Bretts Precision Engineering Co., Ltd.
British Thomson-Houston Co., Ltd., The
Brown Brothers (Aircraft), Ltd.
Cossor Instruments, Ltd.
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Gabriel Manufacturing Co., Ltd.
General Electric Co., Ltd., The
Kent, Ltd., George
Lancefield Aircraft Components, Ltd.
Light Enginering Designs (Gosport), Ltd.
Lion Electronic Developments, Ltd.
M. L. Aviation Co., Ltd.
Measuring Instruments (Pullin), Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Pye Telecommunications, Ltd.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Saunders-Roe, Ltd.
Sciaky Electric Welding Machines, Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Thermionic Products Ltd.
W.S. Electronics (Production), Ltd.
Venner, Ltd.
Western Manufacturing (Reading), Ltd.
Wayne Kerr Laboratories, Ltd., The
Whittemore (Aeradio), Ltd., A. J.

ENGINE COMPONENTS, GENERAL (piston engines)

Aerocontacts (Aircraft Distributors), Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
Auto-Klean Strainers, Ltd.
Avica Equipment, Ltd.
Birkett, Billington and Newton, Ltd.
Bloctube Controls, Ltd.
Bretts Precision Engineering Co., Ltd.
Brown Brothers (Aircraft), Ltd.
Brown Industries, Ltd., David
Brown, Ltd., S. G.
Campbell (Engineers), Ltd., J. R.
Centrax, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
E.N.V. Engineering Co., Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Hughes Engineering Co. (Leicester), Ltd.
Jessop and Sons, Ltd., William
K.L.G. Sparking Plugs, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Motor Components (Birmingham), Ltd.
Newton and Co., H. T.
Opperman, Ltd. S. E.
Parman Aircraft Supplies, Ltd.
Pipework and Engineering (Bristol), Ltd.
Rotax, Ltd.
Skylines Aircraft Components, Ltd.
Spa Guilds, Ltd.
V.P. Sheet Metal, Ltd.
Vokes, Ltd.
Weyburn Engineering Co., Ltd.
Yorkshire Engineering Supplies, Ltd.

ENGINE COMPONENTS, GENERAL (gas turbines)

Airflow Streamlines, Ltd.
Auto-Klean Strainers, Ltd.
Avica Equipment, Ltd.
Birkett, Billington and Newton, Ltd.
Bloctube Controls, Ltd.
Bretts Precision Engineering Co., Ltd.
Brown Brothers (Aircraft), Ltd.
Brown Industries, Ltd., David
Burnley Aircraft Products, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
E.N.V. Engineering Co., Ltd.
Elliott Brothers (London), Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Hughes Engineering Co. (Leicester), Ltd.
Jessop and Sons, Ltd., William
K.L.G. Sparking Plugs, Ltd.
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Motor Components (Birmingham), Ltd.
Newton and Co., H. T.
Pipework and Engineering (Bristol), Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Skyways, Ltd.
Spa Guilds, Ltd.
Telehoist, Ltd.
V.P. Sheet Metal, Ltd.
Vokes, Ltd.
Weyburn Engineering Co., Ltd.
Yorkshire Engineering Supplies, Ltd.

ENGINE STARTERS AND STARTING EQUIPMENT (see also Ground Power Units)

Aerocontacts (Ground Equipment), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
Auto Diesels, Ltd.
Avica Equipment, Ltd.
British Thomson-Houston Co., Ltd., The
de Havilland Engine Co., Ltd., The
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
Folland Aircraft, Ltd.
Murex Welding Processes, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Partridge, Wilson and Co., Ltd.
Plessey Co., Ltd., The
Quasi-Arc, Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Venner Accumulators, Ltd.
Vernons Industries, Ltd.
Walter, A. J.
Westinghouse Brake and Signal Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.
Williams and James (Engineers), Ltd.

EXPANDED MATERIALS (other than plastics and rubber)

Eagle Aircraft Services, Ltd.
Miles Structural Plastics, Ltd.

EXPERIMENTAL WORK (see Design)

EXTRUSIONS, LIGHT ALLOY

Birmetals, Ltd.
Booth and Co., Ltd., James
Eagle Aircraft Services, Ltd.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kaye, Ltd., E. and E.
Magnesium Elektron, Ltd.
Northern Aluminium Co., Ltd.
Rollet and Co., Ltd., H.
Southern Forge, Ltd.
T.I. Aluminium, Ltd.

EXTRUSIONS, STEEL

Eagle Aircraft Services, Ltd.
Low Moor Fine Steels, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph

FABRICATIONS, SHEET METAL

Aero Controls, Ltd.
Aero Maintenance Equipment, Ltd.
Airflow Streamlines, Ltd.
Air Service Training, Ltd.
Aviation Traders (Engineering), Ltd.
B.K.S. Engineering, Ltd.
Baynes Aircraft Interiors, Ltd.
Briggs Motor Bodies, Ltd.
Burnley Aircraft Products, Ltd.
Centrax, Ltd.
Clapham Park Motors, Ltd.
Clifford Products, Ltd.
Cornercroft, Ltd.
Dart Aircraft, Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Harvey and Co. (London), Ltd., G.A.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd., The
Henshall and Sons (Addlestone), Ltd., W.
Jablo Plastics Industries, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Lusifell Products, Ltd.
Magnesium Elektron, Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Pipework and Engineering (Bristol), Ltd.
Portsmouth Aviation, Ltd.
Redwing, Ltd.
Rubery, Owen and Co., Ltd.
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Samiesbury Engineering, Ltd.
Sankey and Sons, Ltd., Joseph
Serck Radiators, Ltd.
Skyways, Ltd.
Solartron Electronic Group
Thompson Bros. (Bilston), Ltd.
V.P. Sheet Metal, Ltd.
Vosper, Ltd.
Wellwinch Engineering, Ltd.
Western Mfg. (Reading), Ltd.
Wilmot Breeden, Ltd.

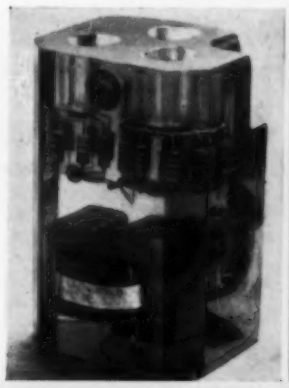
FABRICATIONS, TUBULAR

Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Clapham Park Motors, Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Henshall and Sons (Addlestone), Ltd., W.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
Lusifell Products, Ltd.
Miles, Ltd., F. G.
Oil Feed Engineering Co., Ltd.
Opperman, Ltd., S. E.
Pipework and Engineering (Bristol), Ltd.
Portsmouth Aviation, Ltd.
Reynolds Tube Co., Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Serck Radiators, Ltd.
Simmons and Hawker, Ltd.
Talbot Stead Tube Co., Ltd.
V.P. Sheet Metal, Ltd.
Wellwinch Engineering, Ltd.
Westminster Airways Servicing, Ltd.

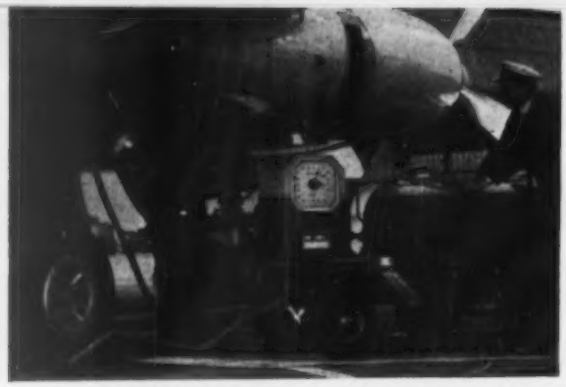
FABRIC, AIRFRAME

Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Brown Brothers (Aircraft), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Firth and Sons, Ltd., T. F.
Portsmouth Aviation, Ltd.
Rumbold and Co., Ltd., L. A.
Vane and Co., A. H.

Epoxy-resin encapsulation by Denis Ferranti (Meters), Ltd.



Anticoustic Mk IIIM headset with noise-cancelling microphone.



Avery-Hardoll dispensing unit supplies water/methanol to a Viscount.

THE ANCILLARY INDUSTRY . . .

FABRIC, CABIN FURNISHING
Aerocontacts (Aircraft Distributors), Ltd.
Baxter, Woodhouse and Taylor, Ltd.
Baynes Aircraft Interiors, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Latex Upholstery, Ltd.
R.F.D. Co., Ltd.
Rumbold and Co., Ltd., L. A.
Vane and Co., A. H.

FANS
(see also Wind Tunnels)
Airscrew Co. and Jicwood, Ltd.
General Electric Co., Ltd., The
Godfrey and Partners, Ltd., Sir George
Hordern-Richmond (Sales), Ltd.
Parman Aircraft Supplies, Ltd.
Plannair, Ltd.

FASTENERS, COWLING AND SPECIAL PURPOSE
Aerocontacts (Sales), Ltd.
Aero Controls, Ltd.
Aerolex, Ltd.
Amal, Ltd.
Aviation Developments, Ltd.
Baynes Aircraft Interiors, Ltd.
Brown Brothers (Aircraft), Ltd.
Dzus Fastener, Europe, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Headland, Ltd., Thos. P.
King Aircraft Corporation
M. L. Aviation Co., Ltd.
Oddie, Bradbury and Cull, Ltd.
Rawlplug Co., Ltd., The
Ross, Ltd., S. Grahame
Salter and Co., Ltd., Geo.
Simmonds Aerocessories, Ltd.

FILLER, FOR TUBE BENDING
Eagle Aircraft Services, Ltd
Mining and Chemical Products, Ltd.

FILTERS, AIR AND GAS
Automotive Products Co., Ltd.
Burgess Products Co., Ltd.
Coopers Mechanical Joints, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Fibreglass, Ltd.
Field Aircraft Services, Ltd.
I.V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Parman Aircraft Supplies, Ltd.
Rellumit (London), Ltd.
Siebe, Gorman and Co., Ltd.
Vokes, Ltd.
Williams and James (Engineers), Ltd.

FILTERS, ELECTRICAL
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
King Aircraft Corporation
McMichael Radio, Ltd.
Murphy Radio, Ltd.
Parman Aircraft Supplies, Ltd.
Savage, Ltd., W. Bryan

FILTERS, FLUID
Amal, Ltd.
Auto-Klean Strainers, Ltd.
Automotive Products Co., Ltd.
British Messier, Ltd.
Coopers Mechanical Joints, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd.
Field Aircraft Services, Ltd.
H.M.L. (Engineering), Ltd.
I. V. Pressure Controllers, Ltd.
Philips Electrical, Ltd.
Rellumit (London), Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Simmonds Aerocessories, Ltd.
Simmons and Hawker, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Stream-Line Filters, Ltd.
Tecalemit, Ltd.
Vokes, Ltd.
Zwicky, Ltd.

FINISHES, AIRCRAFT
(see also Paints)
Aero Research, Ltd.
Aerocontacts (Sales), Ltd.
British Paints, Ltd.
Cellon, Ltd.
Docker Brothers
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Magnesium Elektron, Ltd.
Modern Industrial Finishes, Ltd.
Pyrene Co., Ltd., The

FIRE FIGHTING AND DETECTION EQUIPMENT, AIRBORNE
Cathodeon, Ltd.
Field Aircraft Services, Ltd.
Graviner Manufacturing Co., Ltd.
Kidde Co., Ltd., The Walter
Parman Aircraft Supplies, Ltd.
Pyrene Co., Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Thermal Control Co., Ltd.

FIRE FIGHTING EQUIPMENT GROUND
Aerocontacts (Ground Equipment), Ltd.
Auto Diesels, Ltd.
Bell's Asbestos and Engineering, Ltd.
Douglas Equipment, Ltd.
Foamite, Ltd.
General Fire Appliance Co., Ltd.
Hughes Engineering Co. (Leicester), Ltd.
International Aeradio, Ltd.
Kidde Co., Ltd., The Walter
Pyrene Co., Ltd., The
Rover Gas Turbines, Ltd.
Scottish Aviation, Ltd.
Siebe, Gorman and Co., Ltd.
Thornycroft and Co., Ltd., John I.

FLAME TRAPS
Amal, Ltd.
Bell's Asbestos and Engineering, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Parman Aircraft Supplies, Ltd.

FLAW-DETECTION EQUIPMENT AND MATERIALS
Aerocontacts (Ground Equipment), Ltd.
Brent Chemical Products, Ltd.
Field Aircraft Services, Ltd.
Kelvin and Hughes, Ltd.
Manchester Oil Refinery (Sales), Ltd.
Philips Electrical, Ltd.
R.P.R. Patents, Ltd.

FLOTATION GEAR
Frankenstein and Sons (Manchester), Ltd., P.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., The Walter
Lea Bridge Industries, Ltd.
Parman Aircraft Supplies, Ltd.
R.F.D. Co., Ltd.
Ross, Ltd., S. Grahame

FLUID, HYDRAULIC
Aerocontacts (Ground Equipment), Ltd.
Automotive Products Co., Ltd.
B.P. Aviation Service
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd.
Field Aircraft Services, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Manchester Oil Refinery (Sales), Ltd.
Mobil Oil Co., Ltd.
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.
Wakefield-Dick Industrial Oils, Ltd.

FLUIDS, ETC., INDUSTRIAL (other than under separate headings)
Aerocontacts (Ground Equipment), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Mobil Oil Co., Ltd.
Wakefield and Co., Ltd., C. C.
Wakefield-Dick Industrial Oils, Ltd.

FORGINGS, DROP
English Steel Forge and Engineering Corporation, Ltd.
Firth-Derihon Stampings, Ltd., The
Garringtons, Ltd.
High Duty Alloys, Ltd.
Hughes-Johnson Stampings, Ltd., The
Laycock Engineering, Ltd.
Northern Aluminium Co., Ltd.
Omes, Ltd.

FORGINGS IN HEAT-RESISTING MATERIALS
Hadfields, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Omes, Ltd.

FORGINGS, LIGHT ALLOY
Birmetals, Ltd.
Booth and Co., Ltd., James
High Duty Alloys, Ltd.
Hughes-Johnson Stampings, Ltd., The
Magnesium Elektron, Ltd.
Northern Aluminium Co., Ltd.
Omes, Ltd.
Southern Forge, Ltd.
Stone and Co. (Charlton), Ltd., J.

FORGINGS, STEEL
English Steel Forge and Engineering Corporation, Ltd.
Flather, Ltd., W. T.
Hadfields, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Laycock Engineering, Ltd.
Omes, Ltd.
Steel, Peech and Tozer

FORGINGS, OTHER THAN ABOVE
Hadfields, Ltd.
Hughes-Johnson Stampings, Ltd., The
Jessop and Sons, Ltd., William
Omes, Ltd.
Stone and Co. (Charlton), Ltd., J.
Tubes, Ltd.
Vosper, Ltd.

FREIGHT HANDLING EQUIPMENT, AIRPORT
Aerocontacts (Ground Equipment), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Aero Maintenance Equipment, Ltd.
Aviation Traders (Engineering), Ltd.
Clapham Park Motors, Ltd.
Eccles (Birmingham), Ltd.
Electro-Hydraulics, Ltd.
Heston Aircraft and Associated Engineers, Ltd.
Mercury Truck and Tractor Co., Ltd., The
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame

FREIGHT EQUIPMENT, AIRBORNE
Aerolex, Ltd.
Aviation Traders (Engineering), Ltd.
Baynes Aircraft Interiors, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Latex Upholstery, Ltd.
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.

FRICTION LININGS
Field Aircraft Services, Ltd.

FUELS, AIRCRAFT
British Petroleum Co., Ltd., The
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd.
Field Aircraft Services, Ltd.
Mobil Oil Co., Ltd.
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.
Skyways, Ltd.

FUELS, ROCKET, ETC.
British Oxygen Gases, Ltd.
British Petroleum Co., Ltd., The
Laporte Chemicals, Ltd.
Regent Oil Co., Ltd.
Shell-Mex and B.P., Ltd.

FUELLING EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Avery-Hardoll, Ltd.
Boorn and Co., Ltd., Thomas
Douglas Equipment, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
High Pressure Components, Ltd.
King Aircraft Corporation
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Rellumit (London), Ltd.
Saunders-Roe, Ltd.
Saunders Valve Co., Ltd.
Simmons and Hawker, Ltd.
Telehoist, Ltd.
Thompson Bros. (Bilston), Ltd.
Vosper, Ltd.
Zwicky, Ltd.

FUEL MEASUREMENT EQUIPMENT
Amal, Ltd.
Avery-Hardoll, Ltd.
Elliott Brothers (London), Ltd.
Field Aircraft Services, Ltd.
Firth Cleveland Instruments, Ltd.
H.M.L. (Engineering), Ltd.
Integral, Ltd.
Kent, Ltd., George
Negretti and Zambra, Ltd.
Parman Aircraft Supplies, Ltd.
Saunders Valve Co., Ltd.
Scottish Distributors, Ltd.
Simmons and Hawker, Ltd.
Smiths Aircraft Instruments, Ltd.
Waymouth Gauges and Instruments, Ltd.

FUEL SYSTEMS, ENGINE
Dowty Fuel Systems, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hobson, Ltd., H. M.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Smith's Aircraft Instruments, Ltd.
Waymouth Gauges and Instruments, Ltd.
Wilmot Breeden, Ltd.

FURNISHING EQUIPMENT, AIRCRAFT
Aerocontacts (Aircraft Distributors), Ltd.
Aerolex, Ltd.
Baynes Aircraft Interiors, Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Irwin and Partners, Ltd., E. G.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Lea Bridge Industries, Ltd.
Parnall and Co., Ltd., George
Portsmouth Aviation, Ltd.
Rumbold and Co., Ltd., L. A.
Thermo-Plastics, Ltd.

FUSES
Aerocontacts (Sales), Ltd.
Belling and Lee, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Henley's Telegraph Works Co., Ltd. W. T.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

GALLEY EQUIPMENT
Aerocontacts (Aircraft Distributors), Ltd.
Airwork, Ltd.
Attewell and Sons, Ltd., B.
Avimo, Ltd.
Dart Aircraft, Ltd.
Delaney-Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Henshall and Sons (Addlestone), Ltd., W.
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Ross, Ltd., S. Grahame
Saunders Valve Co., Ltd.

GASKETS
Aircraft Materials, Ltd.
Bell's Asbestos and Engineering Ltd.
Brown Brothers (Aircraft), Ltd.
Clayton-Wright, Ltd., Howard
Coopers Mechanical Joints, Ltd.

(*continued on page 355*)

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S.B.A.C. Stand No.: 34
2nd-8th September 1957
PRIVATE DAYS: 2nd, 3rd, 4th, 5th
PUBLIC DAYS: 6th, 7th, 8th

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THE ANCILLARY INDUSTRY . . .

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Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hall and Hall, Ltd.
Jablo Plastics Industries, Ltd.
Kautex, Ltd.
Parman Aircraft Supplies, Ltd.
Precision Rubbers, Ltd.
Sanders (Electronics), Ltd., W. H.
Spencer Moulton and Co., Ltd., George
Standard Insulator Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Trist and Co., Ltd., Ronald

GAUGES, STRAIN

Appleby and Ireland, Ltd.
Eagle Aircraft Services, Ltd.
Elliott Brothers (London), Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Kelvin and Hughes, Ltd.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Saunders-Roe, Ltd.

GEARS AND GEAR SYSTEMS

British Thomson-Houston Co., Ltd., The
Brown, Ltd., S. G.
Campbell (Engineers), Ltd., J. R.
D. and P. Tools
Eagle Aircraft Services, Ltd.
English Electric Co., Ltd.
E. N. V. Engineering Co., Ltd.
Gear Grinding Co., Ltd., The
Graseby Instruments, Ltd.
H.M.L. (Engineers), Ltd.
Pullin and Co., Ltd., R. B.
Tufnol, Ltd.
Vactric (Control Equipment), Ltd.
Western Manufacturing (Reading), Ltd.

GENERATORS, ELECTRIC

Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
British Thomson-Houston Co., Ltd., The
City Electrical Co.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
International Aeradio, Ltd.
Newman Industries, Ltd.
Newton and Co., H. T.
Newton Brothers (Derby), Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Savage, Ltd., W. Bryan
Stewart Aeronautical Supply Co., Ltd.
Vactric (Control Equipment), Ltd.
Vernons Industries, Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

GLASS, SAFETY

Suntex Safety Glass Industries, Ltd.
Triplex Safety Glass Co., Ltd., The

GRINDING EQUIPMENT
(see also Tools, Machine)

Aerocontacts (Ground Equipment), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Black and Decker, Ltd.
Flexible Drives (Gilmans), Ltd.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd.
Morris, Ltd., B. O.
Reilly Engineering, Ltd.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.

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(see also Engine Starters)

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Aeronautical Trades and Manufacturing Co., Ltd.
Aero Maintenance Equipment, Ltd.
Auto Diesels, Ltd.
City Electrical Co.
Clapham Park Motors, Ltd.
Murex Welding Processes, Ltd.
Parman Aircraft Supplies, Ltd.
Partridge, Wilson and Co., Ltd.
Quasi-Arc, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Venner Accumulators, Ltd.
Vernons Industries, Ltd.
Westinghouse Brake and Signal Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

GUNS.—see Armament

GYRO INSTRUMENTS

Eagle Aircraft Services, Ltd.
Elliott Brothers (London), Ltd.
E.M.O. Instrumentation, Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Honeywell-Brown, Ltd.
Kelvin and Hughes (Aviation), Ltd.
Muirhead and Co., Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Pullin and Co., Ltd., R. B.
Reid and Sigrist, Ltd.
Scottish Distributors, Ltd.
Smiths Aircraft Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Walter, A. J.

HAIR, RUBBERIZED
(for Packaging, upholstery, etc.)

Baynes Aircraft Industries, Ltd.
Eagle Aircraft Services, Ltd.
Hairlok Co., Ltd., The
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Microcell, Ltd.
Rumbold and Co., Ltd., L. A.

HANDLING EQUIPMENT, AIRCRAFT
(other than tractors)

Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Autoset (Production), Ltd.
Aviation Traders (Engineering), Ltd.
Clapham Park Motors, Ltd.
Dancer and Hearne Bros., Ltd.
Eagle Aircraft Services, Ltd.
Eccles (Birmingham), Ltd.
Field Aircraft Services, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Light Engineering Designs (Gosport), Ltd.
Lusifell Products, Ltd.
M. L. Aviation Co., Ltd.
Mercury Truck and Tractor Co., Ltd., The
Morfax, Ltd.
Parman Aircraft Supplies, Ltd.
Portsmouth Aviation, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Vernons Industries, Ltd.

HANGARS

Aerocontacts (Ground Equipment), Ltd.
British Insulated Callender's Cables, Ltd.
Coseley Engineering Co., Ltd., The
Hawksley S. M. D., Ltd.
Lea Bridge Industries, Ltd.

HANGARAGE

Airwork, Ltd.
Aviation Traders (Engineering), Ltd.
Derby Aviation, Ltd.
Samlesbury Engineering, Ltd.
Skyways, Ltd.

HARNESSES, AIRCREW, AND FITTINGS

Aerocontacts (Sales), Ltd.
Aerolex, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
G. Q. Parachute Co., Ltd.
Irving Air Chute of Great Britain, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Rumbold and Co., Ltd., L. A.
Stewart Aeronautical Supply Co., Ltd.

HARNESS, WIRING

Aerocontacts (Sales), Ltd.
Avica Equipment, Ltd.
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Murphy Radio, Ltd.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Reliance Electrical Wire Co., Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

HEATERS, AIRCRAFT

Aerocontacts (Ground Equipment), Ltd.
Baxter, Woodhouse and Taylor, Ltd.
Delaney Gallay, Ltd.
Dragonair, Ltd.
Eagle Aircraft Services, Ltd.
French and Sons, Ltd., Thomas
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plannair, Ltd.
Stewart Aeronautical Supply Co., Ltd.

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Aerocontacts (Ground Equipment), Ltd.
Brown Brothers (Aircraft), Ltd.
Cole, Ltd., E. K.
Dragonair, Ltd.
French and Sons, Ltd., Thomas

HEAT-EXCHANGERS

Delahey Gallay, Ltd.
Dragonair, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Godfrey and Partners, Ltd., Sir George
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marston Excelsior, Ltd.
Sankey and Sons, Ltd., Joseph
Serck Radiators, Ltd.
Simmons and Hawker, Ltd.
Walter, A. J.

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(see also Steels; Alloys, ferrous, etc.)

Eagle Aircraft Services, Ltd.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Low Moor Alloy Steelworks, Ltd.
Miles Structural Plastics, Ltd.
Wiggin and Co., Ltd., Henry

HEATING EQUIPMENT, INDUSTRIAL PROCESS

Aerocontacts (Ground Equipment), Ltd.
British Thomson-Houston Co., Ltd., The
Dragonair, Ltd.
French and Sons, Ltd., Thomas
Philips Electrical, Ltd.
Rover Gas Turbines, Ltd.
Standard Telephones and Cables, Ltd.

HELICOPTER AGENCIES AND SPARES
(See also Sales, Helicopter)

Eagle Aircraft Services, Ltd.
Hordern-Richmond (Sales), Ltd.
Newton and Co., H. T.
Skylines Aircraft Components, Ltd.

HIGH-TEST PEROXIDE
(see also Fuels, rocket)

B.P. Aviation Service
Laporte Chemicals, Ltd.

HONEYCOMB, METAL

Aero Research, Ltd.
British Refrasil Co., Ltd., The
Delaney-Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Jablo Propellers, Ltd.
Miles Structural Plastics, Ltd.

HOSE, FLEXIBLE

Accles and Pollock, Ltd.
Aerocontacts (Sales), Ltd.
Automotive Products Co., Ltd.
Avica Equipment, Ltd.
B.X Plastics, Ltd.
Bell's Asbestos and Engineering Ltd.
Boorn and Co., Ltd., Thomas
Bowden (Engineers), Ltd.
Brown Brothers (Aircraft), Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Gabriel Manufacturing Co., Ltd.
Hellermann, Ltd.
High Pressure Components, Ltd.
King Aircraft Corporation
Maricon, Ltd.
Morris, Ltd., B. O.
Oil Feed Engineering Co., Ltd.
Palmer Tyre, Ltd., The
Power Auxiliaries, Ltd.
Skyhi, Ltd.
Siebe, Gorman and Co., Ltd.
Spencer Moulton and Co., Ltd., George
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

HYDRAULIC EQUIPMENT

Aerocontacts (Ground Equipment), Ltd.
Aerocontacts (Sales), Ltd.
Automotive Products Co., Ltd.
Avica Equipment, Ltd.
British Messier, Ltd.
Chamberlain Industries, Ltd.
Dowty Equipment, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
English Electric Co., Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
H.M.L. (Engineering), Ltd.
High Pressure Components, Ltd.
Hobson, Ltd., H. M.
I.V. Pressure Controllers, Ltd.
Integral, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Muirhead and Co., Ltd.
Newton and Co., H. T.
Plessey Co., Ltd., The
Reilly Engineering, Ltd.
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Wakefield and Co., Ltd., C. C.
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Western Manufacturing (Reading), Ltd.
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Field Aircraft Services, Ltd.
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Rotax, Ltd.
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Mollart Engineering Co., Ltd., The
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Rollason Aerocessories, Ltd.
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Field Aircraft Services, Ltd.
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Kelvin and Hughes (Aviation), Ltd.
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(*continued overleaf*)

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Skylines Aircraft Components, Ltd.
Smiths Aircraft Instruments, Ltd.
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Test Equipment, Ltd.
Venner, Ltd.
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Whittemore (Aeradio), Ltd., A. J.
Wynn and Co. (Aircraft), Ltd., E. D.

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British Refrasil Co., Ltd., The
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Ferranti, Ltd.
Fibreglass, Ltd.
Field Aircraft Services, Ltd.
Hellermann, Ltd.
Henley's Wireless Telegraph Co., Ltd., W. T.
K.L.G. Sparking Plugs, Ltd.
Lion Electronic Developments, Ltd.
Minnesota Mining and Manufacturing Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
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Turner Brothers Asbestos Co., Ltd.
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Aerocontacts (Aircraft Distributors), Ltd.
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Cullum and Co., Ltd., Horace W.
Detuners, Ltd.
Eagle Aircraft Services, Ltd.
Fibreglass, Ltd.
Field Aircraft Services, Ltd.
Jablo Plastics Industries, Ltd.
Miles Structural Plastics, Ltd.
Rumbold and Co., Ltd., L. A.

INSULATION, THERMAL

Aerocontacts (Aircraft Distributors), Ltd.
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Bell's Asbestos and Engineering Ltd.
British Refrasil Co., Ltd., The
Burnley Aircraft Products, Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Fibreglass, Ltd.
Field Aircraft Services, Ltd.
Jablo Plastics Industries, Ltd.
K.L.G. Sparking Plugs, Ltd.
Miles Structural Plastics, Ltd.
Rumbold and Co., Ltd., L. A.
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Dunlop Rubber Co., Ltd.
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Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Hymatic Engineering Co., Ltd., The
Integral, Ltd.
Leytonstone Jig and Tool Co., Ltd.
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Pulsometer Engineering Co., Ltd., The
Reilly Engineering, Ltd.
Rotax, Ltd.
Turner Manufacturing Co., Ltd.
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Mercury Truck and Tractor Co., Ltd.
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Ross, Ltd., S. Grahame
Skyhi, Ltd.
Telehoist, Ltd.
Wakefield and Co., Ltd., C. C.
Westminster Airways Servicing, Ltd.

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Attewell and Sons, Ltd., B.
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Avimo, Ltd.
Bretts Precision Engineering Co., Ltd.
Cornercroft, Ltd.
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Fairey Aviation Co., Ltd., The
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Henshall and Sons (Addlestone), Ltd., W.
Heston Aircraft and Associated Engineers, Ltd.
Hordern-Richmond (Sales), Ltd.
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Irwin and Partners, Ltd., E. G.
Jameson, Ltd., J. L.
Jig Design and Engineering Co.
Lancefield Aircraft Components, Ltd.
Miles, Ltd., F. G.
Mollart Engineering Co., Ltd., The
Morfax, Ltd.
Morris, Ltd., B. O.
Pipework and Engineering (Bristol), Ltd.
Reilly Engineering, Ltd.
Ross, Ltd., S. Grahame
Sanders (Electronics), Ltd., W. H.
Skyways, Ltd.
Spa Guilds, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Tufnol, Ltd.
Western Manufacturing (Reading), Ltd.
Woodside Die Sinking Co., Ltd.

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Field Aircraft Services, Ltd.
Hordern-Richmond, Ltd.
I. V. Pressure Controllers, Ltd.
Purefoy Unit Tooling, Ltd., J. B.
Western Manufacturing (Reading), Ltd.
Woodside Die Sinking Co., Ltd.

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(see also Gaskets; Sealants; and Sealants, Runway Jointing)

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Cellon, Ltd.
Clayton-Wright, Ltd., Howard
Coopers Mechanical Joints, Ltd.
Docker Brothers
Dunlop Rubber Co., Ltd.
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Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The
Hall and Hall, Ltd.
Jablo Propellers, Ltd.
Kautex, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Leytonstone Jig and Tool Co., Ltd.
Precision Rubbers, Ltd.
Standard Insulator Co., Ltd., The
Telegraph Construction and Maintenance Co., Ltd., The
Wills Pressure Filled Joint Ring, Ltd.

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Avica Equipment, Ltd.
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Field Aircraft Services, Ltd.
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Laycock Engineering, Ltd.
Mollart Engineering Co., Ltd., The

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Boulton Paul Aircraft, Ltd.
Bryans Aeroquipment, Ltd.
City Electrical Co.
Cossor Instruments, Ltd.
Eagle Aircraft Services, Ltd.
French and Sons, Ltd., Thomas
Graseby Instruments, Ltd.
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Hendrey Relays, Ltd.
Light Engineering Designs (Gosport), Ltd.
Marconi Instruments, Ltd.
McInnes, Ltd., Dobbie
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Pye, Ltd.
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Savage, Ltd., W. Bryan
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Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
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Ross, Ltd., S. Grahame
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Elliot Equipment, Ltd.
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Frankenstein and Sons (Manchester), Ltd., P.
Jablo Plastics Industries, Ltd.
Lea Bridge Industries, Ltd.
Parman Aircraft Supplies, Ltd.
R.F.D. Co., Ltd.

Black and Decker rescue saw.

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Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Easco Electrical (Holdings), Ltd.
Elliot Equipment, Ltd.
Field Aircraft Services, Ltd.
Ferranti (Meters), Ltd., Denis
Frankenstein and Sons (Manchester), Ltd., P.
Irving Air Chute of Great Britain, Ltd.
Jablo Plastics Industries, Ltd.
Kidde Co., Ltd., Walter, The
Lea Bridge Industries, Ltd.
M. L. Aviation Co., Ltd.
Parman Aircraft Supplies, Ltd.
R.F.D. Co., Ltd.
Redwing, Ltd.
Schermuly Pistol Rocket Apparatus, Ltd., The
Siebe, Gorman and Co., Ltd.
Sparklets, Ltd.
Teleflex Products, Ltd.
Thornycroft and Co., Ltd., John I.
Ultra Electric, Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Aeronautical Trades and Manufacturing Co., Ltd.
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Eagle Aircraft Services, Ltd.
Easco Electrical (Holdings), Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Light Engineering Designs (Gosport), Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Siemens, Edison Swan, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Suntex Safety Glass Industries, Ltd.
Venner, Ltd.

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Aerocontacts (Ground Equipment), Ltd.
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City Electrical Co.
Eagle Aircraft Services, Ltd.
Easco Electrical (Holdings), Ltd.
Eastern Aero Electrical Services, Ltd.
General Electric Co., Ltd., The
International Aeradio, Ltd.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Siemens, Edison Swan, Ltd.

LIGHTING, FACTORY AND OFFICE

Aerocontacts (Ground Equipment), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
C.W.C. Equipment, Ltd.
City Electrical Co.
Eagle Aircraft Services, Ltd.
Easo Electrical (Holdings), Ltd.
General Electric Co., Ltd., The
Philips Electrical, Ltd.
Siemens Edison Swan, Ltd.
Suntex Safety Glass Industries, Ltd.

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Aircraft Materials, Ltd.
Dowty Seals, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.

LOCKNUTS

Aircraft Materials, Ltd.
Aviation Developments, Ltd.
Brown Brothers (Aircraft), Ltd.
Dowty Seals, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Miller Aviation, Ltd.
Newton and Co., Ltd., L. H.
Simmonds Aerocessories, Ltd.
Stewart Aeronautical Supply Co., Ltd.
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LOCKS, DOOR

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Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
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Ross, Ltd., S. Grahame

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British Petroleum Co., Ltd., The
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd., The
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Manchester Oil Refinery (Sales), Ltd.
Mobil Oil Co., Ltd.
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Shell-Mex and B.P., Ltd.
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Aerocontacts (Ground Equipment), Ltd.
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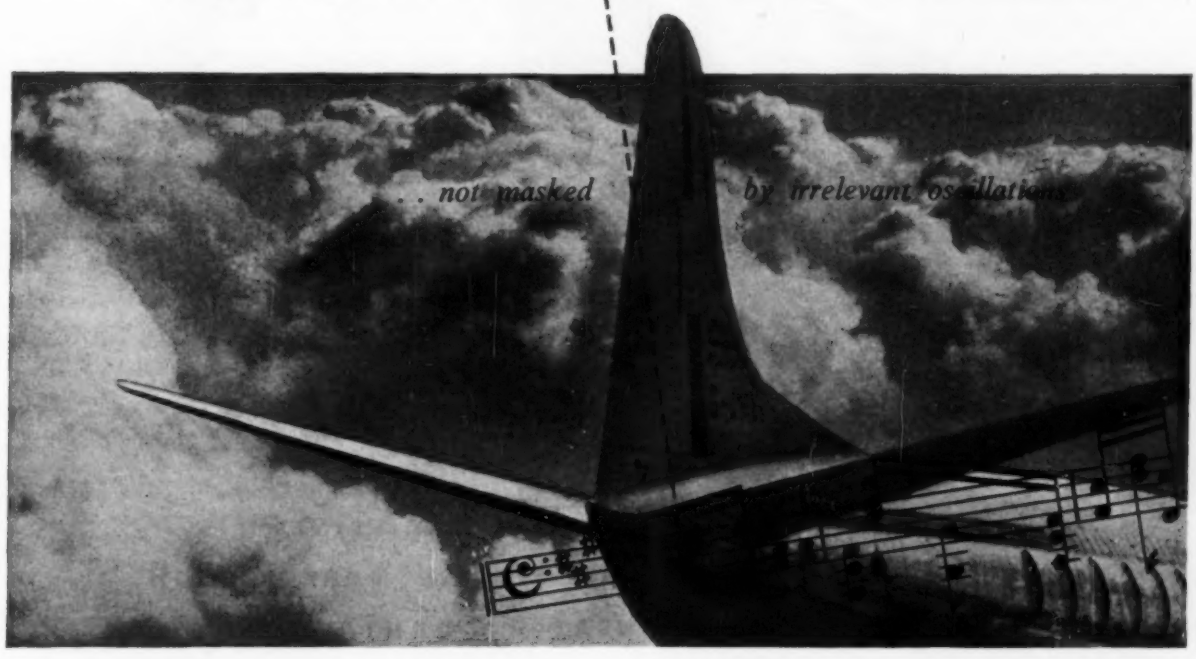

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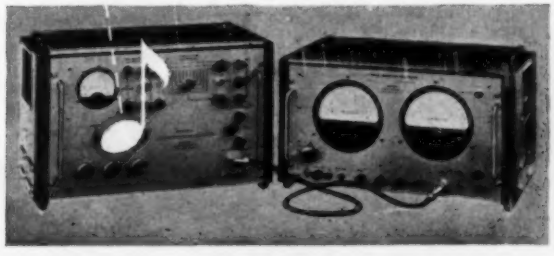

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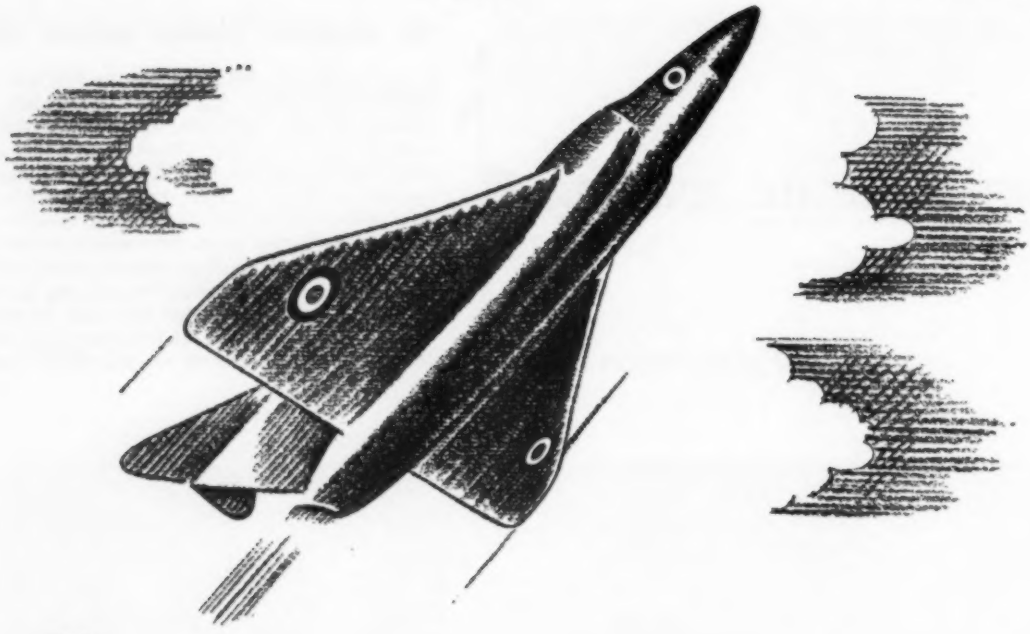

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Parman Aircraft Supplies, Ltd.
Rotax, Ltd.
Skylines Aircraft Components, Ltd.
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Rubery, Owen and Co., Ltd.
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Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Pye Telecommunications, Ltd.
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Bretts Precision Engineering Co., Ltd.
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de Havilland Propellers, Ltd.
Delaney Gallay, Ltd.
Dunlop Rubber Co., Ltd.
E.R.S. (London), Ltd.
Elliott Brothers (London), Ltd.
English Electric Co., Ltd.
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Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
French and Sons, Ltd., Thomas
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Hobson, Ltd., H. M.
Honeywell-Brown, Ltd.
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Lancefield Aircraft Components Ltd.
Leytonstone Jig and Tool Co., Ltd.
Marston Excelsior, Ltd.
Microcell, Ltd.
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Newton and Co., H. T.
Normalair, Ltd.
Palmer Tyre, Ltd., The
Plessey Co., Ltd., The
Portsmouth Aviation, Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Redwing, Ltd.
Reid and Sigrist, Ltd.
Reilly Engineering, Ltd.
Rotol, Ltd.
Sanders (Electronics), Ltd., W. H.
Sankey and Sons, Ltd., Joseph
Savage, Ltd., W. Bryan
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Southern Instruments, Ltd.
Sperry Gyroscope Co., Ltd.
Thermo-Plastics, Ltd.
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Morfax, Ltd.
Saben, Hart and Partners, Ltd.
Severn-Lamb
Test Equipment (Models), Ltd.
Westway Models, Ltd.
Woodside Die Sinking Co., Ltd.

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Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
British Thomson-Houston Co., Ltd., The
Brown, Ltd., S. G.
City Electrical Co.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Kelvin and Hughes, Ltd.
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Parman Aircraft Supplies, Ltd.
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Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Vactric (Control Equipment), Ltd.
Vernons Industries, Ltd.
Western Manufacturing (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.

MOUNTINGS, SHOCK-ABSORBING
Aerocontacts (Sales), Ltd.
Cementation (Muffelite), Ltd.
Clayton-Wright, Ltd., Howard
Dowty Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Long and Hambly, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Peradin and Watercraft, Ltd.
Precision Rubbers, Ltd.
Silentbloc, Ltd.
Stewart Aeronautical Supply Co., Ltd.

MUFFLERS, GROUND, FOR JET ENGINES
Cementation (Muffelite), Ltd.
Cullum and Co., Ltd., Horace W.
Curran, Ltd., John
Detuners, Ltd.

NAMEPLATES
Aeroplastics, Ltd.
Bakelite, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
London Name Plate Manufacturing Co., Ltd., The
Metal Gravure Co., Ltd., The
Parman Aircraft Supplies, Ltd.
Vosper, Ltd.

NAVIGATIONAL AIDS
Brown, Ltd., S. G.
Cossor, Ltd., A. C.
Decca Navigator Co., Ltd., The
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
International Aeradio, Ltd.
London Name Plate Manufacturing Co., Ltd., The
Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Pullin and Co., Ltd., R. B.
Redifon, Ltd.
Rose Brothers (Gainsborough), Ltd.
Sperry Gyroscope Co., Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

NAVIGATORS' PERSONAL INSTRUMENTS
Aerocontacts (Sales), Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Kelvin and Hughes (Aviation), Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Rose Brothers (Gainsborough), Ltd.
Scottish Distributors, Ltd.
Stewart Aeronautical Supply Co., Ltd.

NUTS.—see A.G.S. Parts, also Locknuts

OIL COOLERS
Aerocontacts (Sales), Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Serck Radiators, Ltd.
Walter, A. J.

OVERHAUL, ENGINE (see also Servicing)
Air Engine Services (U.S.-U.K.), Ltd.
Airwork, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Helliwells, Ltd.
Rover Gas Turbines, Ltd.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Vosper, Ltd.
Warden Aviation and Engineering Co.

OXYGEN AND/OR EQUIPMENT
Aerocontacts (Sales), Ltd.
Avimo, Ltd.
British Oxygen Aro Equipment, Ltd.
British Oxygen Gases, Ltd.
Ferranti (Meters), Ltd., Denis
Graseby Instruments, Ltd.
Hymatic Engineering Co., Ltd., The
I.V. Pressure Controllers, Ltd.
Kidde Co., Ltd., The Walter
Lewis, Ltd., D.
Newton and Co., H. T.
Normalair, Ltd.
Parman Aircraft Supplies, Ltd.
Rose Brothers (Gainsborough), Ltd.
Scottish Distributors, Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.

PACKAGING EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Brand and Co., Ltd., R. A.
B.X. Plastics, Ltd.
King Aircraft Corporation
Reynolds (Packaging), Ltd.
Xetal Products, Ltd.

PACKAGING, PRESERVATION AND DISPATCH
Aeroplastics, Ltd.
Airwork, Ltd.
Avimo, Ltd.
Brand and Co., Ltd., R. A.
Dallas (Kingston), Ltd.
Export Packing Service, Ltd.
Ferranti (Meters), Ltd., Denis
Jablo Plastics Industries, Ltd.
Microcell, Ltd.
Park, Ltd., R. and J.
Reynolds (Packaging), Ltd.
Salter and Co., Ltd., Geo.
Samlesbury Engineering, Ltd.
Scotney, Ltd., Tom M.
Telegraph Construction and Maintenance Co., Ltd.
Tropical Preservation Co., Ltd.

PACKINGS.—See Jointing Materials, Seals, Gaskets

PAINT REMOVERS
Brent Chemical Products, Ltd.
British Paints, Ltd.
Cellon, Ltd.
Docker Brothers
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Modern Industrial Finishes, Ltd.
Valay Industries, Ltd.
Vulcan Products, Ltd.

PAINTS, OTHER THAN AIRCRAFT FINISHES AND PROTECTIVE PROCESSES
British Paints, Ltd.
Cellon, Ltd.
Docker Brothers
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hall and Sons (Bristol and London), Ltd., John
Imperial Chemical Industries, Ltd.
Kenilworth Manufacturing Co., Ltd., The
Modern Industrial Finishes, Ltd.
Vulcan Products, Ltd.

PARACHUTES, AIRCREW
Aerocontacts (Sales), Ltd.
Elliot Equipment, Ltd.
G. Q. Parachute Co., Ltd.
Irving Air Chute of Great Britain, Ltd.
Parman Aircraft Supplies, Ltd.
Redwing, Ltd.

PARACHUTES, SPECIAL PURPOSE, OTHER THAN AIRCREW
Aerocontacts (Sales), Ltd.
Eliot Equipment, Ltd.
Field Aircraft Services, Ltd.
G.Q. Parachute Co., Ltd.
Irving Air Chute of Great Britain, Ltd.
Lea Bridge Industries, Ltd.
Parman Aircraft Supplies, Ltd.
Redwing, Ltd.

PARTS, MACHINED
Aircraft Materials, Ltd.
Air Service Training, Ltd.
Aviation Traders (Engineering), Ltd.
Birkett, Billington and Newton, Ltd.
British Wire Products, Ltd.
Brown Brothers (Aircraft), Ltd.
C.J.C. Developments (Portsmouth), Ltd.
Campbell (Engineers), Ltd., J. R.
Cornercroft, Ltd.
D. and P. Tools
Eagle Aircraft Services, Ltd.
Engineering Products, Ltd.
E.R.S. (London), Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Helliwells, Ltd.
Henshall and Sons (Addlestone), Ltd., W.
Jig Design and Engineering Co., Ltd.
Kent Alloys, Ltd.
King Aircraft Corporation
Lancefield Aircraft Components, Ltd.
Laycock Engineering, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Marston Excelsior, Ltd.
M.H H. Engineering Co., Ltd.
Miles, Ltd., F. G.

(*continued overleaf*)

THE ANCILLARY INDUSTRY . . .

Parts, Machined (continued)

Miles Structural Plastics, Ltd.
Morfax, Ltd.
Morris, Ltd., B. O.
Motor Components (Birmingham), Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
Opperman, Ltd., S. E.
Perry Barr Metal Co., Ltd.
Pipework and Engineering (Bristol), Ltd.
Plessey Co., Ltd., The
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rubery, Owen and Co., Ltd.
Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
Sanders (Electronics), Ltd., W. H.
Skyways, Ltd.
Spa Guilds, Ltd.
Talbot Stead Tube Co., Ltd.
Telehoist, Ltd.
Tufnol, Ltd.
Turner Manufacturing Co., Ltd.
Vernons Industries, Ltd.
V.P. Sheet Metal, Ltd.
Western Manufacturing (Reading), Ltd.
Westminster Airways Servicing, Ltd.
Woodside Die Sinking Co., Ltd.
Y.S.C., Ltd., The
Yorkshire Engineering Supplies, Ltd.

PARTS, TUBULAR

Aviation Developments, Ltd.
Aviation Traders (Engineering), Ltd.
Dancer and Hearne Bros., Ltd.
Field Aircraft Services, Ltd.
Henshall and Sons (Addlestone), Ltd., W.
High Pressure Components, Ltd.
Lea Bridge Industries, Ltd.
Morfax, Ltd.
Reynolds Tube Co., Ltd.
Rollason Aerocessories, Ltd.
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Simmons and Hawker, Ltd.
Spa Guilds, Ltd.
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.
Tufnol, Ltd.
V.P. Sheet Metal, Ltd.
Western Mfg. (Reading), Ltd.

PHOTOGRAMMETRIC EQUIPMENT

Aerocontacts (Sales), Ltd.
Meridian Airmaps, Ltd.
Williamson Manufacturing Co., Ltd.

PHOTOGRAPHY, AERIAL

Aerofilms, Ltd.
B.K.S. Engineering, Ltd.
Derby Aviation, Ltd.
Fairey Air Surveys, Ltd.
Harringay Photographic and Electrical Supplies, Ltd.
Kodak, Ltd.
Meridan Airmaps, Ltd.
Parman Aircraft Supplies, Ltd.
Stewart Aeronautical Supply Co., Ltd.

PHOTOGRAPHY, GENERAL

Harringay Photographic and Electrical Supplies, Ltd.
Kodak, Ltd.
Meridian Airmaps, Ltd.
Parman Aircraft Supplies, Ltd.

PIEZO-ELECTRIC MATERIALS

Aerocontacts (Sales), Ltd.
Brush Crystal Co., Ltd.
General Electric Co., Ltd.
Technical Ceramics, Ltd.
Whittemore (Aeradio), Ltd., A. J.

PISTONS AND RINGS

Air Engine Services (U.S.-U.K.), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hepworth and Grandage (Yeadon), Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.

PLASTIC METAL FILLERS

Aero Research, Ltd.
Kenilworth Manufacturing Co., Ltd.

PLASTICS, EXPANDED

Aeroplastics, Ltd.
Baynes Aircraft Interiors, Ltd.
Jablo Plastics Industries, Ltd.
Jet Tanks
Miles, Ltd., F. G.
Miles Structural Plastics, Ltd.
Saunders-Roe, Ltd.
Thermo-Plastics, Ltd.

PLASTICS, EXTRUSIONS

B.X. Plastics, Ltd.
Baynes Aircraft Interiors, Ltd.
Cole, Ltd. E. K.
Hellermann, Ltd.
Jet Tanks
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Oil Feed Engineering Co., Ltd.
Siemens Edison Swan, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The

PLASTICS, FABRICATED

Aerocontacts (Aircraft Distributors), Ltd.
Aeroplastics, Ltd.
Ashdowns, Ltd.
Aston and Co., Ltd., E. S.
Attewell and Sons, Ltd., B.
Baynes Aircraft Interiors, Ltd.
Cole, Ltd., E. K.
Dart Aircraft, Ltd.
Hellermann, Ltd .
Jablo Plastics Industries, Ltd.
Jet Tanks
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
Lion Electronic Developments, Ltd.
M.L. Aviation Co., Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Parnall and Co., Ltd., George
Siemens Edison Swan, Ltd.
Suntex Safety Glass Industries, Ltd.
Thermo-Plastics, Ltd.
Triplex Safety Glass Co., Ltd.
Tufnol, Ltd.
Wills Pressure Filled Joint Ring, Ltd.

PLASTICS, GLASS FIBRE

Aeroplastics, Ltd.
Aero Research, Ltd.
Ashdowns, Ltd.
Baynes Aircraft Interiors, Ltd.
Chelton (Electrostatics), Ltd.
Dart Aircraft, Ltd.
Eagle Aircraft Services, Ltd.
Ferranti (Meters), Ltd., Denis Ferro Enamels, Ltd.
Hordern-Richmond (Sales), Ltd.
Jablo Plastics Industries, Ltd.
Jet Tanks
Kidde Co., Ltd., The Walter
Lion Electronic Developments, Ltd.
M. L. Aviation Co., Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Saro Laminated Wood Products, Ltd.
Siemens Edison Swan, Ltd.
Thermo-Plastics, Ltd.
Turner Brothers Asbestos Co., Ltd.

PLASTICS, LAMINATED

Aeroplastics, Ltd.
Airscrew Co. and Jicwood, Ltd.
Ashdowns, Ltd.
B.X. Plastics, Ltd.
Bakelite, Ltd.
Brand and Co., Ltd., R. A.
Dart Aircraft, Ltd.
Jablo Plastics Industries, Ltd.
Jet Tanks
Marston Excelsior, Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Siemens Edison Swan, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.

PLASTICS, MOULDED

Aerocontacts (Aircraft Distributors), Ltd.
Aeroplastics, Ltd.
Attewell and Sons, Ltd., B.
B. X. Plastics, Ltd.
Chelton (Electrostatics), Ltd.
Clayton-Wright, Ltd., Howard
Cole, Ltd., E. K.
Ferranti (Meters), Ltd., Denis
General Electric Co., Ltd., The
Hellermann, Ltd.
Jet Tanks
Lion Electronic Developments, Ltd.
Long and Hambly, Ltd.
Marston Excelsior, Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Reliance Electrical Wire Co., Ltd., The
Siemens Edison Swan, Ltd.
Suntex Safety Glass Industries, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Walker (A. D.), Ltd., James
Western Manufacturing (Reading), Ltd.

PLASTICS, RAW MATERIALS

Aero Research, Ltd.
B.X. Plastics, Ltd.
Bakelite, Ltd.
Ferro Enamels, Ltd.
Fireproof Tanks, Ltd.
Imperial Chemical Industries, Ltd.
Jet Tanks
Kodak, Ltd.
Laporte Chemicals, Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Turner Brothers Asbestos Co., Ltd.

PLASTICS, SHEETING

Attewell and Sons, Ltd., B.
B.X. Plastics, Ltd.
Bakelite, Ltd.
Dunlop Rubber Co., Ltd., Dulon Division
Eagle Aircraft Services, Ltd.
Fireproof Tanks, Ltd.
Jablo Plastics Industries, Ltd.
Jet Tanks, Ltd.
Kodak, Ltd.
Lancefield Aircraft Components, Ltd.
Microcell, Ltd.
Miles Structural Plastics, Ltd.
Saro Laminated Wood Products, Ltd.
Siemens Edison Swan, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.

PLATING EQUIPMENT, ELECTRO-

Aerocontacts (Ground Equipment), Ltd.
Partridge, Wilson and Co., Ltd.
Westinghouse Brake and Signal Co., Ltd.

PLUGS, SPARKING AND IGNITER

Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
K.L.G. Sparking Plugs, Ltd.
Lodge Plugs, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Scottish Distributors, Ltd.
Smiths Aircraft Instruments, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.

PLYWOOD

Aerocontacts (Sales), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Miles Structural Plastics, Ltd.

PNEUMATIC SYSTEMS

British Messier, Ltd.
Dunlop Rubber Co., Ltd.
Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
V. P. Sheet Metal, Ltd.
Western Mfg. (Reading), Ltd.
Westinghouse Brake and Signal Co., Ltd.

PRESSES

Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.

PRESSURE VESSELS

British Messier, Ltd.
Dunlop Rubber Co., Ltd.
Firth and John Brown, Ltd., Thos.
Harvey and Co. (London), Ltd., G. A.
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.
Reynolds Tube Co., Ltd.
Rotax, Ltd.
Simmons and Hawker, Ltd.

PRESSURIZATION EQUIPMENT.—see Air Conditioning

PRESSWORK

Airflow Streamlines, Ltd.
Attewell and Sons, Ltd., B.
Briggs Motor Bodies, Ltd.
British Wire Products, Ltd.
Clifford Products, Ltd.
Cornercroft, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd.
Henshall and Sons (Addlestone), Ltd. W.
Heston Aircraft and Associated Engineers, Ltd.
Imperial Chemical Industries, Ltd.
Jablo Plastics Industries, Ltd.
Jet Tanks
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Miles Structural Plastics, Ltd.
Morfax, Ltd.
Pipework and Engineering (Bristol), Ltd.
Ratcliffe (Rochdale), Ltd., F. S.
Ross, Courtney and Co., Ltd.
Rubery, Owen and Co., Ltd.
Rumbold and Co., Ltd. L. A.
Sanders (Electronics), Ltd., W. H.
Sankey and Sons, Ltd., Joseph
Self-Priming Pump and Engineering Co., Ltd.
Steel Stampings, Ltd.
Thompson Bros. (Bilston), Ltd.
V. P. Sheet Metal, Ltd.
Western Mfg. (Reading), Ltd.

PROPELLERS AND ASSOCIATED EQUIPMENT

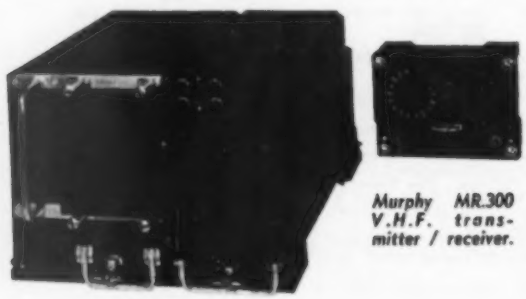
Aerocontacts (Aircraft Distributors), Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
Airscrew Co. and Jicwood, Ltd.
de Havilland Propellers, Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hordern-Richmond (Sales), Ltd.
Morfax, Ltd.
Parman Aircraft Supplies, Ltd.
Reilly Engineering, Ltd.
Rotol, Ltd.
Walter, A. J.

PROTECTIVE PROCESSES (other than aircraft finishes)

Aerocontacts (Ground Equipment), Ltd.
Aeroplastics, Ltd.
Aero Research, Ltd.
Brand and Co., Ltd., R. A.
British Paints, Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Hall and Sons (Bristol and London), Ltd., John
Kenilworth Manufacturing Co., Ltd., The
Modern Industrial Finishes, Ltd.
Murphy Radio, Ltd.
Peradin and Watercraft, Ltd.
Pyrene Co., Ltd., The
Valay Industries, Ltd.
Wakefield and Co., Ltd., C. C.
Walterisation Co., Ltd., The

PUBLICATIONS, TECHNICAL AND GENERAL

Aviation and Engineering Projects, Ltd.
Beaumont Aviation Literature
Boulton Paul Aircraft, Ltd.
Faber and Faber, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Iliffe and Sons, Ltd.
International Aeradio, Ltd.
Lusifell Products, Ltd.
Meridian Airmaps, Ltd.
Pitman and Sons, Sir Isaac
Portsmouth Aviation, Ltd.
Wakefield and Co., Ltd., C. C.



Murphy MR.300 V.H.F. transmitter / receiver.

PUBLIC ADDRESS EQUIPMENT, AIRBORNE
Aerocontacts (Sales), Ltd.
Easco Electrical (Holdings), Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Murphy Radio, Ltd.
Philips Electrical, Ltd.
Pye, Ltd.
Redifon, Ltd.
Standard Telephones and Cables, Ltd.
Ultra Electric, Ltd.
Whittemore (Aeradio), Ltd., A. J.

PUBLIC-ADDRESS EQUIPMENT, GROUND
Aerocontacts (Ground Equipment), Ltd.
British Thomson-Houston Co., Ltd.
Easco Electrical (Holdings), Ltd.
General Electric Co., Ltd., The
International Aeradio, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Philips Electrical, Ltd.
Pye, Ltd.
Pye Telecommunications, Ltd.
Standard Telephones and Cables, Ltd.

PUMPS, AIR PRESSURE AND VACUUM
Dunlop Rubber Co., Ltd.
Field Aircraft Services, Ltd.
Godfrey and Partners, Ltd., Sir George
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pulsometer Engineering Co., Ltd., The
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Scottish Distributors, Ltd.
Skylines Aircraft Components, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Wakefield and Co., Ltd., C. C.
Walter, A. J.

PUMPS, FUEL AND OIL
Amal, Ltd.
Dowty Fuel Systems, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hobson, Ltd., H. M.
Lucas (Gas Turbine Equipment), Ltd., Joseph.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pulsometer Engineering Co., Ltd. The
Rotax, Ltd.
Rover Gas Turbines, Ltd.
Saunders Valve Co., Ltd.
Scottish Distributors, Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Simmons and Hawker, Ltd.
Skylines Aircraft Components, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.
Zwicky, Ltd.

PUMPS, HYDRAULIC
Aero Maintenance Equipment, Ltd.
Automotive Products Co., Ltd.
Boulton Paul Aircraft, Ltd.
British Messier, Ltd.
Chamberlain Industries, Ltd.
Clapham Park Motors, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Fielding and Platt, Ltd.
H.M.L. (Engineering), Ltd.
Hobson, Ltd., H. M.
Integral, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pulsometer Engineering Co., Ltd., The
Scottish Distributors, Ltd.
Skyhi, Ltd.
Skylines Aircraft Components, Ltd.
Sperry Gyroscope Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telehoist, Ltd.
Turner Manufacturing Co., Ltd.
Walter, A. J.
Weyburn Engineering Co., Ltd.

PYROTECHNICS
Aerocontacts (Sales), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Schermuly Pistol Rocket Apparatus, Ltd., The
Stewart Aeronautical Supply Co., Ltd.
Y.S.C., Ltd., The

RADAR EQUIPMENT AND COMPONENTS
Aerocontacts (Sales), Ltd.
Appleby and Ireland, Ltd.
Bretts Precision Engineering Co. Ltd.
Bardolph and Partners, Ltd., J. F.
British Thomson-Houston Co., Ltd., The
Brown Brothers (Aircraft), Ltd.
Cossor, Ltd., A. C.
Decca Radar, Ltd.
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Gabriel Manufacturing Co., Ltd.
General Electric Co., Ltd., The
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
Lion Electronic Developments, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Marston Excelsior, Ltd.
Miles Structural Plastics, Ltd.
Morfax, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Opperman, Ltd., S. E.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Sanders (Electronics), Ltd., W. H.
Standard Insulator Co., Ltd., The
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tecalemit, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermo-Plastics, Ltd.
Whittemore (Aeradio), Ltd., A. J.

RADIO EQUIPMENT AND COMPONENTS
Aerocontacts (Sales), Ltd.
Airwork, Ltd.
Bretts Precision Engineering Co., Ltd.
British Brown-Boveri, Ltd.
Brown Brothers (Aircraft), Ltd.
Brush Crystal Co., Ltd.
Cathodeon, Ltd.
Decca Navigator Co., Ltd., The
E.R.S. (London), Ltd.
Eagle Aircraft Services, Ltd.
Ekco Electronics, Ltd.
Elliott Brothers (London), Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
International Aeradio, Ltd.
Lion Electronic Developments, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
McMichael Radio, Ltd.
Murphy Radio, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey, Co., Ltd., The
Pye, Ltd.
Pye Telecommunications, Ltd.
Redifon, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Standard Insulator Co., Ltd., The
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Tecalemit, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thermionic Products, Ltd.
Thermo-Plastics, Ltd.
W. S. Electronics (Production), Ltd.
Whittemore (Aeradio), Ltd., A. J.

RADIO INSTALLATIONS, PLANNING AND SUPPLY OF
Airwork, Ltd.
British Aviation Services (Engineering), Ltd.
British Brown-Boveri, Ltd.
Cossor, Ltd., A. C.
Eagle Aircraft Services, Ltd.
General Electric Co., Ltd., The
Helliwells, Ltd.
International Aeradio, Ltd.
Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Plessey Co., Ltd., The
Pye, Ltd.
Pye Telecommunications, Ltd.
Redifon, Ltd.
Savage, Ltd., W. Bryan
Skyways, Ltd.
Standard Telephones and Cables, Ltd.
W. S. Electronics (Production), Ltd.
Whittemore (Aeradio), Ltd., A. J.

RADIOGRAPHY AND X-RAY EQUIPMENT
General Electric Co., Ltd., The
Helliwells, Ltd.
Ilford, Ltd.
Kodak, Ltd.
Marconi Instruments, Ltd.
Philips Electrical, Ltd.

RADOMES
Fairey Marine, Ltd.
Lea Bridge Industries, Ltd.
Marston Excelsior, Ltd.
Microcell, Ltd.
Miles, Ltd., F. G.
Miles Structural Plastics, Ltd.
Thermo-Plastics, Ltd.
Whittemore (Aeradio), Ltd., A. J.

RECORDERS, SOUND
Aeronautical Trades and Manufacturing Co., Ltd.
International Aeradio, Ltd.
Philips Electrical, Ltd.
Pye, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Test Equipment, Ltd.
Thermionic Products, Ltd.
Whittemore (Aeradio), Ltd., A. J.

RECTIFIERS
Aerocontacts (Sales), Ltd.
British Brown-Boveri, Ltd.
British Thomson-Houston Co., Ltd., The
English Electric Co., Ltd.
Ferranti, Ltd.
General Electric Co., Ltd., The
Parman Aircraft Supplies, Ltd.
Partridge, Wilson and Co., Ltd.
Philips Electrical, Ltd.
Plessey Co., Ltd., The
Quasi-Arc, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
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Whittemore (Aeradio), Ltd., A. J.

REFRACTORY MATERIALS
Delaney Gallay, Ltd.
K.L.G. Sparking Plugs, Ltd.

REFUELLERS.—see Fuelling Equipment

RELAYS, ELECTRICAL
Aerocontacts (Sales), Ltd.
Avimo, Ltd.
British Brown-Boveri, Ltd.
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D. and P. Tools
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Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Fonadek (Branson), Ltd.
General Electric Co., Ltd., The
Hendrey Relays, Ltd.
International Aeradio, Ltd.
Measuring Instruments (Pullin), Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Sangamo Weston, Ltd.
Smiths Aircraft Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd.
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Whittemore (Aeradio), Ltd.

RELEASES, PARACHUTE, DROP-TANK, ETC.
Aerolex, Ltd.
Aircraft Materials, Ltd.
Ferranti (Meters), Ltd., Denis
G.Q. Parachute Co., Ltd.
M.L. Aviation Co., Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame

REPAIR, AIRFRAME
Air Service Training, Ltd.
Aviation Traders (Engineering), Ltd.
B.K.S. Engineering, Ltd.
British Aviation Services (Engineering), Ltd.
Brooklands Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hants and Sussex Aviation, Ltd.
Helliwells, Ltd.
Miles, Ltd., F. G.
Rollason Aircraft and Engines, Ltd.
Samlesbury Engineering, Ltd.
Skyways, Ltd.
Warden Aviation and Engineering Co.

REPAIR, ENGINE
Aviation Traders (Engineering), Ltd.
B.K.S. Engineering, Ltd.
Eagle Aircraft Services, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Helliwells, Ltd.
Rollason Aircraft and Engines, Ltd.
Samlesbury Engineering, Ltd.
Warden Aviation and Engineering Co.

RESCUE.—see Life-saving Equipment

RESISTORS
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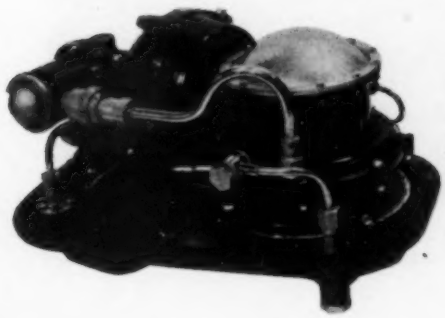
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
French and Sons, Ltd., Thomas
General Electric Co., Ltd., The
Muirhead and Co., Ltd.
Murphy Radio, Ltd.
International Aeradio, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pye, Ltd.
Salford Electrical Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

RHEOSTATS
Aerocontacts (Sales), Ltd.
British Thomson-Houston Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

RIVETS.—see A.G.S. Parts



Air turbine driven fuel booster pump, output up to 5,000 gal/hr at 11 lb/sq in at air inlet pressure of 70 lb/sq in (Self-Priming Pump and Engineering Co., Ltd.).

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RIVETING EQUIPMENT
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Aviation Developments, Ltd.
Bardolph and Partners, Ltd., J. F.
Brown Brothers (Aircraft), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.

RUBBER, EXPANDED
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Palmer Tyre, Ltd., The

RUBBER, GENERAL AND MECHANICAL
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Boorn and Co., Ltd., Thomas
British Paints, Ltd.
Clayton-Wright, Ltd., Howard
Dowty Seals, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Esso Petroleum Co., Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
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Newton and Co., H. T.
Oil Feed Engineering Co., Ltd.
Palmer Tyre, Ltd., The
Peradin and Watercraft, Ltd.
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Spencer Moulton and Co., Ltd., George
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(see also Corrosion Inhibitors, and Protective Processes)
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Pyrene Co., Ltd., The
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Derby Aviation, Ltd.
Dundas, Ltd., R. K.
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Field Aircraft Services, Ltd.
Folland Aircraft, Ltd.
Hants and Sussex Aviation, Ltd.
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Newton and Co., H. T.
Rollason Aircraft and Engines, Ltd.
Shackleton, Ltd., W. S.
Walter, A. J.
Warden Aviation and Engineering Co.
Whittemore (Aeradio), Ltd., A. J.

SALES, ENGINE
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Aviation Traders, Ltd.
Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Newton and Co., H. T.
Rollason Aircraft and Engines, Ltd.
Rover Gas Turbines, Ltd.
Shackleton, Ltd., W. S.
Walter, A. J.
Warden Aviation and Engineering Co.

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Aerocontacts (Aircraft Distributors), Ltd.
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SCRAP, PURCHASE OF
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Trist and Co., Ltd., Ronald

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Hellermann, Ltd.
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Precision Rubbers, Ltd.
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Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Equipment and Engineering, Ltd.
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Henshall and Sons (Addlestone), Ltd., W.
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Lea Bridge Industries, Ltd.
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Rumbold and Co., Ltd., L. A.
Samlesbury Engineering, Ltd.
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Henshall and Sons (Addlestone), Ltd., W.
M. L. Aviation Co., Ltd.
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Aviation Traders (Engineering), Ltd.
B.K.S. Engineering, Ltd.
British Aviation Services (Engineering), Ltd.
Brooklands Aviation, Ltd.
Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
Hants and Sussex Aviation, Ltd.
Helliwells, Ltd.
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Miles, Ltd., F. G.
Rollason Aircraft and Engines, Ltd.
Samlesbury Engineering, Ltd.
Skyways, Ltd.
Warden Aviation and Engineering Co.

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E.R.S. (London), Ltd.
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Easco Electrical (Holdings), Ltd.
Field Aircraft Services, Ltd.
Helliwells, Ltd.
International Aeradio, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Lion Electronic Developments, Ltd.
Miles, Ltd., F. G.
Murphy Radio, Ltd.
Pye, Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Air Engine Services (U.S.-U.K.), Ltd.
Airwork, Ltd.
Aviation Traders (Engineering), Ltd.
B.K.S. Engineering, Ltd.
British Aviation Services (Engineering), Ltd.
Derby Aviation, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hants and Sussex Aviation, Ltd.
Helliwells, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Rollason Aircraft and Engines, Ltd.
Rover Gas Turbines, Ltd.
Samlesbury Engineering, Ltd.
Scottish Aviation, Ltd.
Skyways, Ltd.
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British Aviation Services (Engineering), Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Leytonstone Jig and Tool Co., Ltd.
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Pullin and Co., Ltd., R. B.
Skyways, Ltd.
Walter, A. J.

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Newmark, Ltd., Louis
Plessey Co., Ltd., The
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Walter, A. J.
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Wilmot Breeden, Ltd.

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Booth and Co., Ltd., James
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Heston Aircraft and Associated Engineers, Ltd.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Magnesium Elektron, Ltd.
Northern Aluminium Co., Ltd.
Rollet and Co., Ltd., H.
Samlesbury Engineering, Ltd.
Serck Radiators, Ltd.
T.I. Aluminium, Ltd.

SHEET METAL WORK—see Fabrications, also Presswork

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Coopers Mechanical Joints, Ltd.
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Tufnol, Ltd.

SHOCK ABSORBERS.—see Mountings

SHUTTERS.—see Doors

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Curran, Ltd., John
Detuners, Ltd.
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Vokes, Ltd.

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Long and Hambly, Ltd.
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Telegraph Construction and Maintenance Co., Ltd., The

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Aircraft Materials, Ltd.
Eagle Aircraft Services, Ltd.
Henley's Telegraph Works Co., Ltd., The
Light Soldering Developments, Ltd.
Sheffield Smelting Co., Ltd., The
Standard Telephones and Cables, Ltd.

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Avimo, Ltd.
British Messier, Ltd.
British Thomson-Houston Co., Ltd., The
D. and P. Tools
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Scottish Distributors, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Western Manufacturing (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.

SOUNDPROOFING MATERIALS
Aerocontacts (Aircraft Distributors), Ltd.
Baynes Aircraft Interiors, Ltd.
Bell's Asbestos and Engineering, Ltd.
Cullum and Co., Ltd., Horace W.
Detuners, Ltd.
Field Aircraft Services, Ltd.
Hairlok Co., Ltd., The
Jablo Plastics Industries, Ltd.
Miles Structural Plastics, Ltd.
Rumbold and Co., Ltd., L. A.
Whittemore (Aeradio), Ltd., A. J.

SPARES, SUPPLY OF
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Aerocontacts (Sales), Ltd.
Aeronautical Radio Services, Ltd.
Aeronautical Trades and Manufacturing Co., Ltd.
Air Engine Services (U.S.-U.K.), Ltd.
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Brown Brothers (Aircraft), Ltd.
Curd Components, Ltd.
Dundas, Ltd., R. K.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Rover Gas Turbines, Ltd.
Shackleton, Ltd., W. S.
Skyways, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.
Y.S.C., Ltd., The

SPRAYING EQUIPMENT (for paint, etc.)
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Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hymatic Engineering Co., Ltd., The
Lacy-Hulbert and Co., Ltd.

SPRINGS
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Ferranti (Meters), Ltd., Denis
Fox and Co., Ltd., Samuel
Ratcliffe (Rochdale), Ltd., F. S.
Salter and Co., Ltd., Geo.
Terry and Sons, Ltd., Herbert

STABILIZERS, AUTOMATIC
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Newmark, Ltd., Louis

STAGINGS, PLATFORMS, ETC., ASSEMBLY AND MAINTENANCE
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
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(continued on page 361)

ADDRESSES OF COMPANIES: pages 363-368

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Integrated Control Systems

In conjunction with its development of integrated flying control and instrument systems, Sperry has now produced a simulator for testing such systems under fully realistic flight conditions, which ranks amongst the most advanced installations of this type in the industry.

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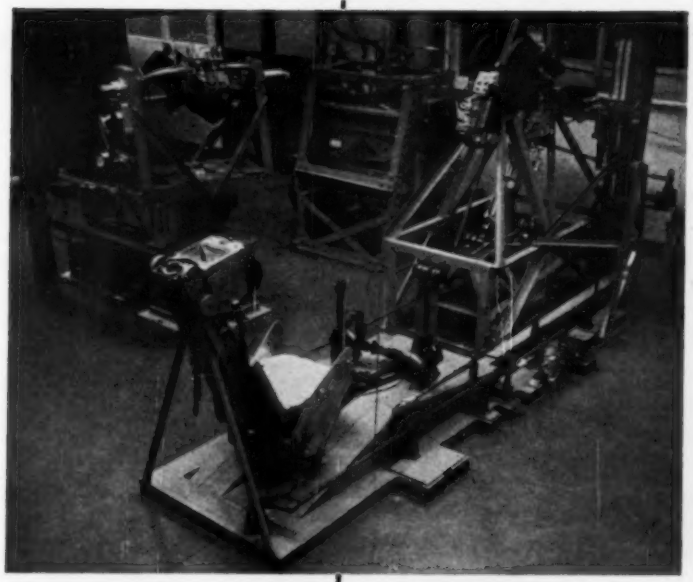
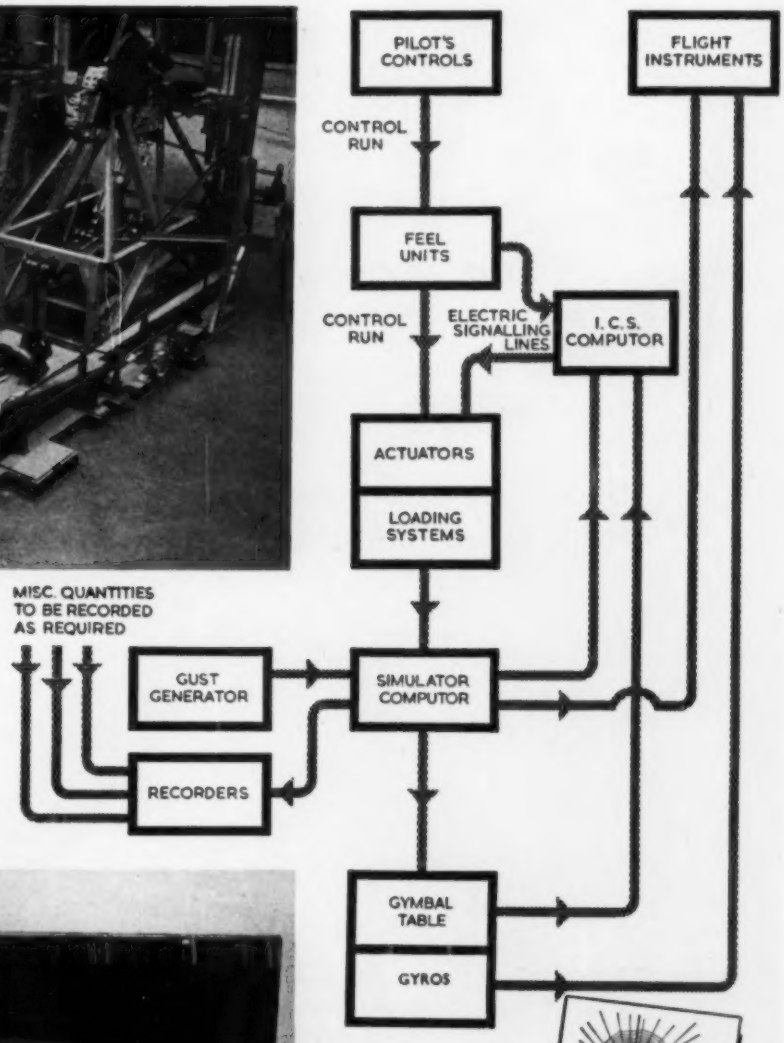
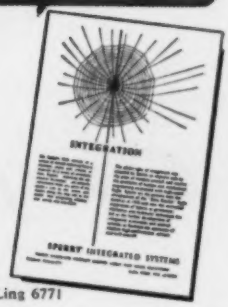


General view of the Sperry Simulator Laboratory



The Sperry Simulator Computor



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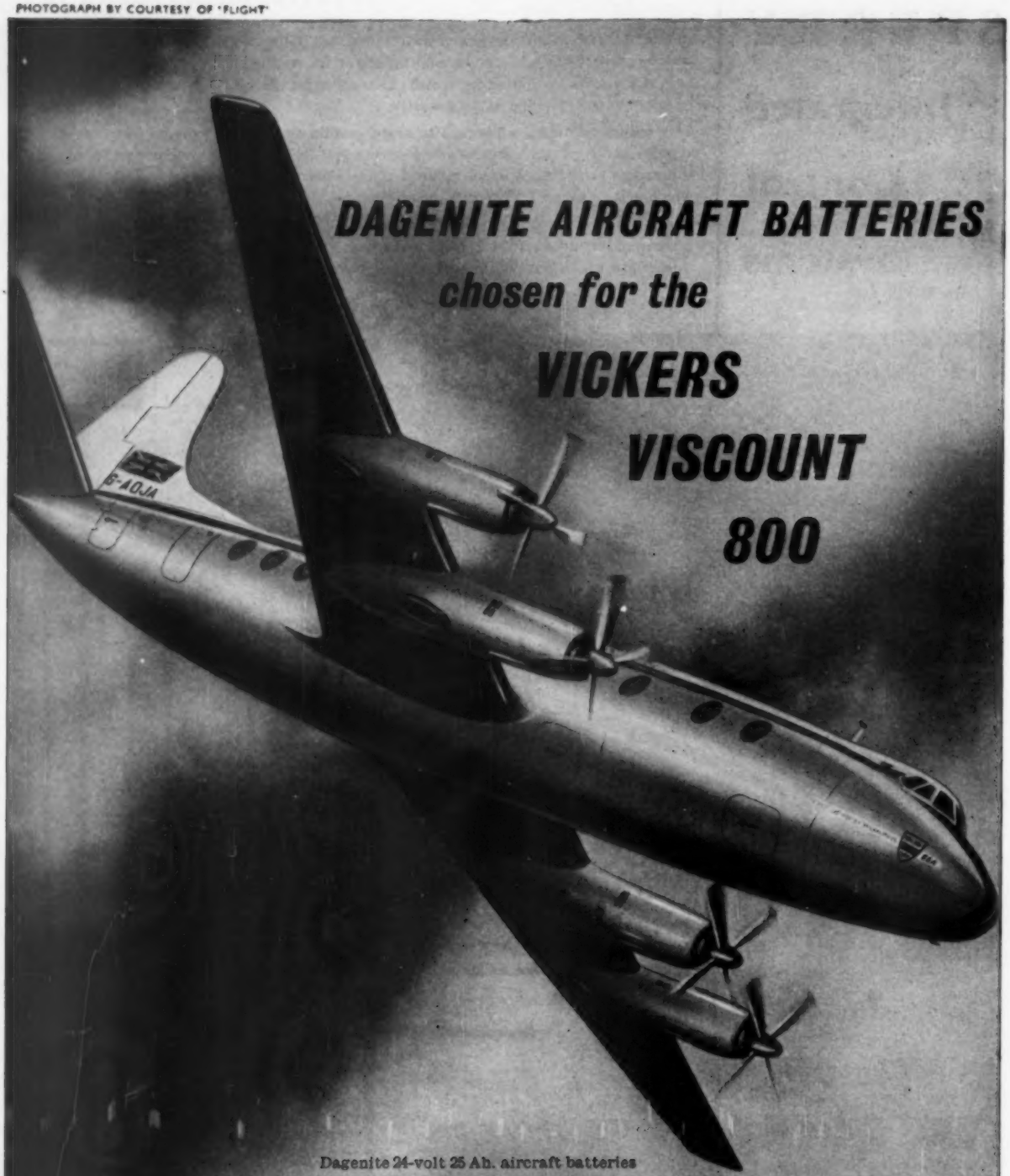

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Ross, Ltd., S. Grahame
Samlesbury Engineering, Ltd.

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Aviation Traders (Engineering), Ltd.
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Eagle Aircraft Services, Ltd.
Eccles (Birmingham), Ltd.
Field Aircraft Services, Ltd.
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Henshall and Sons (Addlestone), Ltd., W.
M. L. Aviation Co., Ltd.
Mercury Truck and Tractor Co., Ltd., The
Morfax, Ltd.
Parman Aircraft Supplies, Ltd.
Pipework and Engineering (Bristol), Ltd.
Ross, Ltd., S. Grahame
Rover Gas Turbines, Ltd.
Walter, A. J.

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Firth-Vickers Stainless Steels, Ltd.
Flather, Ltd., W. T.
Fox and Co., Ltd., Samuel
Habershon and Sons, Ltd., J. J.
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
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Kiveton Park Steel and Wire Works, Ltd.
Low Moor Alloy Steelworks, Ltd.
Phosphor Bronze Co., Ltd.
Steel, Peech and Tozer

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Eagle Aircraft Services, Ltd.
Firth-Vickers Stainless Steels, Ltd.
Fox and Co., Ltd., Samuel
Habershon and Sons, Ltd., J. J.
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Kiveton Park Steel and Wire Works, Ltd.
Low Moor Alloy Steelworks, Ltd.
Phosphor Bronze Co., Ltd.

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Eagle Aircraft Services, Ltd.
Firth-Vickers Stainless Steels, Ltd.
Flather, Ltd., W. T.
Fox and Co., Ltd., Samuel
Hadfields, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Kayser, Ellison and Co., Ltd.
Kiveton Park Steel and Wire Works, Ltd.
Low Moor Alloy Steelworks, Ltd.
Phosphor Bronze Co., Ltd.

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Dart Aircraft, Ltd.
Field Aircraft Services, Ltd.
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Heston Aircraft and Associated Engineers, Ltd.
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
Lea Bridge Industries, Ltd.
Mercury Truck and Tractor Co., Ltd., The
Morfax, Ltd.
Parman Aircraft Supplies, Ltd.
Ross, Ltd., S. Grahame
Samlesbury Engineering, Ltd.
V.P. Sheet Metal, Ltd.

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Fairey Air Surveys, Ltd.
Hunting Aerosurveys, Ltd.
Meridan Airmaps, Ltd.

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Burgess Products Co., Ltd.
Eagle Aircraft Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
Ferranti (Meters), Ltd., Denis
Flight Refuelling, Ltd.
Honeywell-Brown, Ltd.
Miles, Ltd., F. G.
Munro, Ltd., R. W.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pye, Ltd.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Thermal Control Co., Ltd.
Trist and Co., Ltd., Ronald
Vactric (Control Equipment), Ltd.
Venner, Ltd.
Western Manufacturing (Reading), Ltd.

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Burgess Products Co., Ltd.
C.W.C. Equipment, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Graseby Instruments, Ltd.
Hendrey Relays, Ltd.
Henley's Telegraph Works Co., Ltd., W. T.
Honeywell-Brown, Ltd.
McMichael Radio, Ltd.
Miles, Ltd., F. G.
Muirhead and Co., Ltd.
Newton and Co., H. T.
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Pye, Ltd.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
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Trist and Co., Ltd., Ronald
Vactric (Control Equipment), Ltd.
Venner, Ltd.
Western Manufacturing (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.

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Air Service Training, Ltd.
Airflow Streamlines, Ltd.
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Henshall and Sons (Addlestone), Ltd., W.
Jet Tanks
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Marston Excelsior, Ltd.
Miles, Ltd., F. G.
Miles Structural Plastics, Ltd.

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Burnley Aircraft Products, Ltd.
Delaney Gallay, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Fireproof Tanks, Ltd.
Helliwells, Ltd.
Henderson Safety Tank Co., Ltd., The
Henshall and Sons (Addlestone), Ltd., W.
Lancefield Aircraft Components, Ltd.
Marston Excelsior, Ltd.
Redwing, Ltd.
Simmons and Hawker, Ltd.
V. P. Sheet Metal, Ltd.
Vosper, Ltd.
Walter, A. J.

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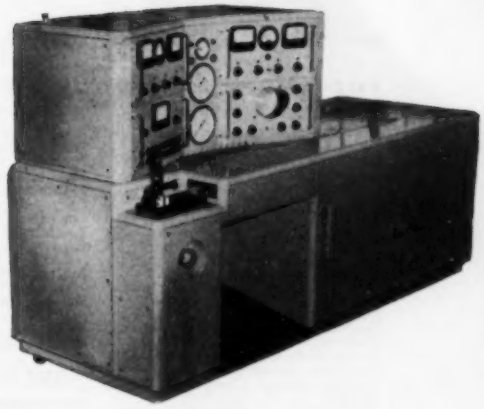
B. X. Plastics, Ltd.
Daimas, Ltd.
Eagle Aircraft Services, Ltd.
Gosheron and Co., Ltd., John
Henley's Wireless Telegraph Co., Ltd., W. T.
Lea Bridge Industries, Ltd.
Minnesota Mining and Engineering Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Vane and Co., A. H.



Servo-dynamic test rig, to simulate complete servo system, for operation by unskilled personnel. Western Manufacturing (Reading), Ltd.

TARGETS.—see Training Equipment

TEMPERATURE-SENSITIVE EQUIPMENT
A. J. W. (Instruments), Ltd.
Appleby and Ireland, Ltd.
K.L.G. Sparking Plugs, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Negretti and Zambra, Ltd.
Salford Electrical Instruments, Ltd.
Sangamo Weston, Ltd.
Teddington Aircraft Controls, Ltd.
Western Mfg. (Reading), Ltd.
Walter, A. J.

TERMINALS
Aerocontacts (Sales), Ltd.
Aircraft Marine Products (Great Britain), Ltd.
Aircraft Materials, Ltd.
Belling and Lee, Ltd.
Brown Brothers (Aircraft), Ltd.
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Hellermann, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Plessey Co., Ltd., The
Pye, Ltd.
Ross, Courtney and Co., Ltd.
Western Manufacturing (Reading), Ltd.

TEST EQUIPMENT, AERODYNAMIC
British Brown-Boveri, Ltd.
Field Aircraft Services, Ltd.
Graseby Instruments, Ltd.
Morfax, Ltd.
Munro, Ltd., R. W.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Test Equipment, Ltd.
Test Equipment (Models), Ltd.

TEST EQUIPMENT ELECTRICAL AND ELECTRONIC
A. J. W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Apoleby and Ireland, Ltd.
Avimo, Ltd.
Boulton Paul Aircraft, Ltd.
British Thomson-Houston Co., Ltd.,
Bryans Aeroquipment, Ltd.
City Electrical Co.
Cossor, Ltd., A. C.
Decca Radar, Ltd.
E.R.S. (London), Ltd.
Easco Electrical (Holdings), Ltd.
Elliott Brothers (London), Ltd.
Fairey Aviation Co., Ltd., The
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Firth Cleveland Instruments, Ltd.
Fonadek (Branson), Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Graseby Instruments, Ltd.
Hendrey Relays, Ltd.
Honeywell-Brown, Ltd.
International Aeradio, Ltd.
Lion Electronic Developments, Ltd.
M. L. Aviation Co., Ltd.
Marconi Instruments, Ltd.
McInnes, Ltd., Dobbie
McMichael Radio, Ltd.
Measuring Instruments (Pullin), Ltd.
Microcell. Ltd.
Miles, Ltd., F. G.
Muirhead and Co., Ltd.
Murphy Radio, Ltd.
Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Pye, Ltd.
Pye Telecommunications, Ltd.
Racal Engineering, Ltd.
Reid and Sigrist, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rotax, Ltd.
Saben, Hart and Partners, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Saunders-Roe, Ltd.
Solartron Electronic Group, Ltd., The
Southern Instruments, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Test Equipment, Ltd.
Thermionic Products, Ltd.
Ultra Electronic, Ltd.
Venner, Ltd.
Wayne Kerr Laboratories, Ltd.
Western Manufacturing (Reading), Ltd.
Whittemore (Aeradio), Ltd., A. J.
Wilmot Breeden, Ltd.
Wynnstruments, Ltd.

TEST EQUIPMENT, HYDRAULIC
A.J.W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Aero Maintenance Equipment, Ltd.
Automotive Products Co., Ltd.
British Messier, Ltd.
Bryans Aeroquipment, Ltd.
Clapham Park Motors, Ltd.
Dowty Equipment, Ltd.
Fairey Aviation Co., Ltd., The
Ferranti (Meters), Ltd., Denis
Fielding and Platt, Ltd.
H. M. L. (Engineering), Ltd.
Helliwells, Ltd.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Integral, Ltd.
International Aeradio, Ltd.
Lancefield Aircraft Components, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Lucas (Gas Turbine Equpiment), Ltd., Joseph
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Saben, Hart and Partners, Ltd.
Southern Instruments, Ltd.
Telehoist, Ltd.
Walter, A. J.
Western Manufacturing (Reading), Ltd.
Wilmot Breeden, Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

TEST EQUIPMENT, INSTRUMENT
A.J.W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Appleby and Ireland, Ltd.
Avo, Ltd.
Bryans Aeroquipment, Ltd.
Cossor Instruments, Ltd.
Dawe Instruments, Ltd.
Elliott Brothers (London), Ltd.
E.M.O. Instrumentation, Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
Firth Cleveland Instruments, Ltd.
Graseby Instruments, Ltd.
Honeywell-Brown, Ltd.
Integral, Ltd.
International Aeradio Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
McInnes, Ltd., Dobbie
Mechanism, Ltd.
Morfax, Ltd.
Muirhead and Co., Ltd.
Munro, Ltd., R. W.
Negretti and Zambra, Ltd.

(*continued overleaf*)

THE ANCILLARY INDUSTRY . . .

Test Equipment, (continued)

Newmark, Ltd., Louis
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Pullin and Co., Ltd., R. B.
Pye, Ltd.
Reid and Sigrist, Ltd.
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Rose Brothers (Gainsborough), Ltd.
Saben, Hart and Partners, Ltd.
Salford Electrical Instruments, Ltd.
Sanders (Electronics), Ltd., W. H.
Sangamo Weston, Ltd.
Savage, Ltd., W. Bryan
Simmonds Aerocessories, Ltd.
Skylines Aircraft Components, Ltd.
Scottish Distributors, Ltd.
Sperry Gyroscope Co., Ltd.
Test Equipment, Ltd.
Test Equipment (Models), Ltd.
Thermionic Products, Ltd.
Walter, A. J.

TEST EQUIPMENT LABORATORY

A.J.W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Amal, Ltd.
Avo, Ltd.
Boulton Paul Aircraft, Ltd.
Bryans Aeroquipment, Ltd.
Cossor Instruments, Ltd.
Dawe Instruments, Ltd.
Ferranti (Meters), Ltd., Denis
Graseby Instruments, Ltd.
H.M.L. (Engineering), Ltd.
Hendrey Relays, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Marconi Instruments, Ltd.
McInnes, Ltd., Dobbie
Muirhead and Co., Ltd.
Munro, Ltd., R. W.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Rollason Aerocessories, Ltd.
Rover Gas Turbines, Ltd.
Saben, Hart and Partners, Ltd.
Sanders (Electronics), Ltd., W. H.
Scottish Distributors, Ltd.
Short and Mason
Southern Instruments, Ltd.
Walter, A. J.
Wayne Kerr Laboratories, Ltd., The
Westminster Airways Servicing, Ltd.

TEST EQUIPMENT MECHANICAL

A.J.W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Appleby and Ireland, Ltd.
Bloctube Controls, Ltd.
Curran, Ltd., John
Ferranti (Meters), Ltd., Denis
Graseby Instruments, Ltd.
Jig Design and Engineering Co.
Leytonstone Jig and Tool Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
McInnes, Ltd., Dobbie
Morfax, Ltd.
Newton and Co., H. T.
Parman Aircraft Supplies, Ltd.
Portsmouth Aviation, Ltd.
Rumbold and Co., Ltd., L. A.
Saben, Hart and Partners, Ltd.
Sanders (Electronics), Ltd., W. H.
Southern Instruments, Ltd.
Telefiex Products, Ltd.
Test Equipment, Ltd.
Walter, A. J.
Western Mfg. (Reading), Ltd.
Wynn and Co. (Aircraft), Ltd., E. D.

TEST EQUIPMENT METALLURGICAL

A.J.W. (Instruments), Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Manchester Oil Refinery (Sales), Ltd.
Newton and Co., H. T.
Philips Electrical, Ltd.
Walter, A. J.

TEST EQUIPMENT PNEUMATIC

A.J.W. (Instruments), Ltd.
Aerocontacts (Ground Equipment), Ltd.
Bryans Aeroquipment, Ltd.
H.M.L. (Engineering), Ltd.
Helliwells, Ltd.
Hymatic Engineering Co., Ltd.
I. V. Pressure Controllers, Ltd.
Lacy-Hulbert and Co., Ltd.
Lea Bridge Industries, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph.
McInnes, Ltd., Dobbie
Newton and Co., H. T.
Rollason Aerocessories, Ltd.
Saben, Hart and Partners, Ltd.
Walter, A. J.
Western Mfg. (Reading), Ltd.

TEST-BED INSTALLATIONS, COMPLETE

Aerocontacts (Ground Equipment), Ltd.
Airwork, Ltd.
City Electrical Co.
Curran, Ltd., John
Fielding and Platt, Ltd.
Heenan and Froude, Ltd.
I. V. Pressure Controllers, Ltd.
Pye, Ltd.
Rover Gas Turbines, Ltd.

THREAD INSERTS

Armstrong Patents Co., Ltd.
Cross Mfg. Co. (1938), Ltd.
Rawlplug Co., Ltd., The

TIMING DEVICES

A.J.W. (Instruments), Ltd.
Appleby and Ireland, Ltd.
British Thomson-Houston Co., Ltd., The
Ferranti (Meters), Ltd., Denis
G.Q. Parachute Co., Ltd.
Graseby Instruments, Ltd.
Irving Air Chute of Great Britain, Ltd.
Sanders (Electronics), Ltd., W. H.
Teddington Aircraft Controls, Ltd.
Thermionic Products, Ltd.
Venner, Ltd.

TITANIUM

Hughes-Johnson Stampings, Ltd., The
Imperial Chemical Industries, Ltd.
Jessop and Sons, Ltd., William
Stone and Co. (Charlton), Ltd., J.

TOE STRAPS, CONTROL

Palmer Tyre, Ltd., The

TOILET EQUIPMENT, AIRCRAFT

Aerocontacts (Ground Equipment), Ltd.
Air Service Training, Ltd.
Baynes Aircraft Interiors, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Henshall and Sons (Addlestone), Ltd., W.
Suntex Safety Glass Industries, Ltd.

TOOLS, CUTTING

D. and P. Tools
Eagle Aircraft Services, Ltd.
English Steel Tool Corporation, Ltd.
Hall and Pickles, Ltd.
Jessop and Sons, Ltd., William
Morris, Ltd., B. O.

TOOLS, ENGINEERS' HAND

Acratork Engineering Co., Ltd.
Aerocontacts (Ground Equipment), Ltd.
Brockhouse and Co., Ltd., J.
Jenks Brothers, Ltd.
Jessop and Sons, Ltd., William
Leytonstone Jig and Tool Co., Ltd.
M.H.H. Engineering Co., Ltd.
Morris, Ltd., B. O.
Scottish Distributors, Ltd.
Simmonds Aerocessories, Ltd.
Tipping and Co., Ltd., C. R.

TOOLS, MACHINE

Aerocontacts (Ground Equipment), Ltd.
C.J.C. Developments (Portsmouth), Ltd.
Eagle Aircraft Services, Ltd.
Engineering Products, Ltd.
Headland, Ltd., Thos. P.
Jameson Ltd., J. L.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd., The
Morris, Ltd., B. O.
Scottish Distributors, Ltd.
T.E. Tools, Ltd.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.
Westminster Airways Servicing, Ltd.

TOOLS, PORTABLE POWER

Aerocontacts (Ground Equipment), Ltd.
Black and Decker, Ltd.
Desoutter Brothers, Ltd.
Flexible Drives (Gilmans), Ltd.
Morris, Ltd., B. O.

TOOLS, PRESS

Aerocontacts (Ground Equipment), Ltd.
Aerolex, Ltd.
Attewell and Sons, Ltd., B.
Cornercroft, Ltd.
D. and P. Tools
Gloster Engineering (Cheltenham), Ltd.
Henderson Safety Tank Co., Ltd., The
Henshall and Sons (Addlestone), Ltd., W.
Hordern-Richmond (Sales), Ltd.
Leytonstone Jig and Tool Co., Ltd.
Miles Structural Plastics, Ltd.
Sanders (Electronics), Ltd., W. H.
T.E. Tools, Ltd.
Thompson (Engineers), Ltd., Raymond F.
Walker (A.D.), Ltd., James
Western Manufacturing (Reading), Ltd.

TOOLS, RIVETING

Aerocontacts (Ground Equipment), Ltd.
Aircraft Materials, Ltd.
Aviation Developments, Ltd.
Eagle Aircraft Services, Ltd.
Fielding and Platt, Ltd.

TOOLS, SPECIAL PURPOSE

Autoset (Production), Ltd.
C.J.C Developments (Portsmouth), Ltd.
Chamberlain Industries, Ltd.
D. and P. Tools
Gear Grinding Co., Ltd., The
Hymatic Engineering Co., Ltd., The
Jenks Brothers, Ltd.
Leytonstone Jig and Tool Co., Ltd.
Mollart Engineering Co., Ltd., The
Morris, Ltd., B. O.
North West Machine Design Co., Ltd.
Rawlplug Co., Ltd., The
Reilly Engineering, Ltd.
Ross. Ltd., S. Grahame
Sanders (Electronics), Ltd., W. H.
T.E. Tools, Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Thompson (Engineers), Ltd., Raymond F.
Van Moppes and Sons (Diamond Tools), Ltd., L. M.
Walker (A.D.), Ltd., James
Woodside Die Sinking Co., Ltd.

TRACTORS, AIRCRAFT.—see also Handling equipment

Aerocontacts (Ground Equipment), Ltd.
Brown Tractors (Engineering), Ltd., David
Douglas Equipment, Ltd.
M.L. Aviation Co., Ltd.
Mercury Truck and Tractor Co., Ltd., The

TRAINING, AIRCREW

Air Service Training, Ltd.
Brooklands Aviation, Ltd.
Derby Aviation, Ltd.
Skyways, Ltd.

TRAINING, TECHNICAL

Air Service Training, Ltd.
Derby Aviation, Ltd.
International Aeradio, Ltd.
Murphy Radio, Ltd.

TRAINING EQUIPMENT, AIRCREW

A.J.W. (Instruments), Ltd.
Air Trainers, Ltd.
Aviation Traders (Engineering), Ltd.
Brooklands Aviation, Ltd.
International Aeradio, Ltd.
M. L. Aviation Co., Ltd.
McInnes, Ltd., Dobbie
Meridian Airmaps, Ltd.
Miles, Ltd., F. G.
Redifon, Ltd.
Scottish Distributors, Ltd.
Solartron Electronic Group
Telehoist, Ltd.
W.S. Electronics (Production), Ltd.
Wilmot Breeden, Ltd.

TRAINING EQUIPMENT, ARMAMENT

Flight Refuelling, Ltd.
Lea Bridge Industries, Ltd.
M.L. Aviation Co., Ltd.
Miles, Ltd., F. G.
Ross, Ltd., S. Grahame

TRANSFERS, LETTERING, ETC.

Parman Aircraft Supplies, Ltd.

TRANSFORMERS

British Thomson-Houston Co., Ltd.
Eagle Aircraft Services, Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Muirhead and Co., Ltd.
Parman Aircraft Supplies, Ltd.
Partridge, Wilson and Co., Ltd.
Plessey Co., Ltd., The
Pullin and Co., Ltd., R. B.
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Stewart Aeronautical Supply Co., Ltd.
Telegraph Construction and Maintenance Co., Ltd., The
Western Mfg. (Reading), Ltd.

TRANSPORT OF AIRCRAFT AND EQUIPMENT. —see Packaging and Dispatch

TRUCKS (Fork-lift, etc.)

Aerocontacts (Ground Equipment), Ltd.
Aviation Traders (Engineering), Ltd.
Eccles (Birmingham), Ltd.
Electro-Hydraulics, Ltd.
Heston Aircraft and Associated Engineers, Ltd.
International Aeradio, Ltd.
Lansing Bagnall, Ltd.
Mercury Truck and Tractor Co., Ltd., The

TUBING, AIRCRAFT, STEEL

Accles and Pollock, Ltd.
Aerocontacts (Sales), Ltd.
Aircraft Materials, Ltd.
Eagle Aircraft Services, Ltd.
Reynolds Tube Co., Ltd.
Saben, Hart and Partners, Ltd.
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.

TUBING, AIRCRAFT STAINLESS

Aerocontacts (Sales), Ltd.
Eagle Aircraft Services, Ltd.
Saben, Hart and Partners, Ltd.
Talbot Stead Tube Co., Ltd.

TUBING, FLEXIBLE.—see Hose, Flexible

TUBING, SEAMLESS

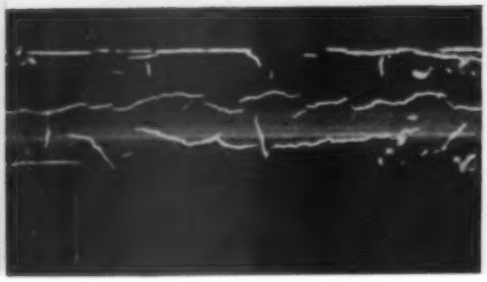
Accles and Pollock, Ltd.
British Aluminium Co., Ltd., The
Eagle Aircraft Services, Ltd.
Oil Feed Engineering Co., Ltd.
Reynolds Tube Co., Ltd.
Rollet and Co., Ltd., H.
Saben, Hart and Partners, Ltd.
Suntex Safety Glass Industries, Ltd.
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.
Wiggin and Co., Ltd., Henry

TUBING, OTHER THAN ABOVE

Accles and Pollock, Ltd.
Birkett, Billington and Newton, Ltd.
Eagle Aircraft Services, Ltd.
High Duty Alloys, Ltd.
Imperial Chemical Industries, Ltd.
Kautex, Ltd.
Kaye, Ltd., E. and E.
Miles Structural Plastics, Ltd.
Northern Aluminium Co., Ltd.
Oil Feed Engineering Co., Ltd.
Saben, Hart and Partners, Ltd.
Serck Radiators, Ltd.
Simmons and Hawker, Ltd.
Suntex Safety Glass Industries, Ltd.
T.I. Aluminium, Ltd.
Talbot Stead Tube Co., Ltd.
Tecalemit, Ltd.
Tufnol, Ltd.

TUBULAR COMPONENTS

Accles and Pollock, Ltd.
Aviation Traders (Engineering), Ltd.
Avica Equipment, Ltd.
Baynes Aircraft Interiors, Ltd.
Dancer and Hearne Bros., Ltd.
High-Pressure Components, Ltd.
Lancefield Aircraft Components, Ltd.
Lucas (Gas Turbine Equipment), Ltd., Joseph
Morfax, Ltd.
Pipework and Engineering (Bristol), Ltd.



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Reynolds Tube Co., Ltd.
Ross, Ltd., S. Grahame
Rumbold and Co., Ltd., L. A.
Talbot Stead Tube Co., Ltd.
Tubes, Ltd.
Tufnol, Ltd.
Western Mfg. (Reading), Ltd.

TYRES AND WHEELS.—see also Brakes
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Firestone Tyre and Rubber Co., Ltd.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd.
Parman Aircraft Supplies, Ltd.
Walter, A. J.

UNDERCARRIAGES.—see Landing Gear

UNIFORM.—see Clothing

UPHOLSTERY MATERIALS. —see also Leather
Aerocontacts (Aircraft Distributors), Ltd.
Baynes Aircraft Interiors, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Firth and Sons, Ltd., T. F.
Hairlok Co., Ltd., The
Jablo Plastics Industries, Ltd.
Lancefield Aircraft Components, Ltd.
Latex Upholstery, Ltd.
Rumbold and Co., Ltd., L. A.

VALVES, ELECTRONIC
Aerocontacts (Sales), Ltd.
British Brown-Boveri, Ltd.
British Thomson-Houston Co., Ltd., The
Eagle Aircraft Services, Ltd.
Ferranti, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Marconi's Wireless Telegraph Co., Ltd.
Murphy Radio, Ltd.
Parman Aircraft Supplies, Ltd.
Pye, Ltd.
Savage, Ltd., W. Bryan
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Whittemore (Aeradio), Ltd., A. J.

VALVES, PISTON-ENGINE
Birkett, Billington and Newton, Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Hughes-Johnson Stampings, Ltd., The
Motor Components (Birmingham), Ltd.
V.P. Sheet Metal, Ltd.
Walter, A. J.

VALVES FOR FLUIDS
Amal, Ltd.
Avery-Hardoll, Ltd.
Birkett, Billington and Newton, Ltd.
British Messier, Ltd.
British Oxygen Aro Equipment, Ltd.
Dowty Equipment, Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Fairey Aviation Co., Ltd., The
Field Aircraft Services, Ltd.
Flight Refuelling, Ltd.
H.M.L. (Engineering), Ltd.
High-Pressure Components, Ltd.
Hymatic Engineering Co., Ltd., The
I. V. Pressure Controllers, Ltd.
Integral, Ltd.
Kidde Co., Ltd., The Walter
Lucas (Gas Turbine Equipment), Ltd., Joseph
Miles Structural Plastics, Ltd.
Palmer Tyre Ltd., The
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Saunders Valve Co., Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Simmons and Hawker, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Talbot Stead Tube Co., Ltd.
Teddington Aircraft Controls, Ltd.
Telehoist, Ltd.
Western Mfg. (Reading), Ltd.
Wilmot Breeden, Ltd.

VALVES FOR AIR AND GASES
Amal, Ltd.
Birkett, Billington and Newton, Ltd.
British Messier, Ltd.
British Oxygen Aro Equipment, Ltd.
Bryans Aeroquipment, Ltd.
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Electro-Hydraulics, Ltd.
Field Aircraft Services, Ltd.
Godfrey and Sons, Ltd., Sir George
Graseby Instruments, Ltd.
High-Pressure Components, Ltd.
Hymatic Engineering Co., Ltd., The
I.V. Pressure Controllers, Ltd.
Kidde Co., Ltd., The Walter
Lucas (Gas Turbine Equipment), Ltd., Joseph
Normalair, Ltd.
Palmer Tyre, Ltd., The
Reilly Engineering, Ltd.
Rollason Aerocessories, Ltd.
Ross, Ltd., S. Grahame
Rotax, Ltd.
Saunders Valve Co., Ltd.
Self-Priming Pump and Engineering Co., Ltd.
Siebe, Gorman and Co., Ltd.
Stewart Aeronautical Supply Co., Ltd.
Teddington Aircraft Controls, Ltd.
Western Mfg. (Reading), Ltd.

VEHICLES (other than categories specifically named)
Aerocontacts (Ground Equipment), Ltd.
Aviation Traders (Engineering), Ltd.
British Oxygen Engineering, Ltd.
Godfrey and Sons, Ltd., Sir George
Mercury Truck and Tractor Co., Ltd., The

VIBRATION GENERATORS
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
General Electric Co., Ltd., The
Goodmans Industries, Ltd.
Newton and Co., H. T.
Rose Bros. (Gainsborough), Ltd.
Savage, Ltd., W. Bryan
Western Mfg. (Reading), Ltd.

VOLTAGE REGULATORS
Aerocontacts (Sales), Ltd.
Avimo, Ltd.
British Brown-Boveri. Ltd.
British Thomson-Houston Co., Ltd., The
Eagle Aircraft Services, Ltd.
Eastern Aero Electrical Services, Ltd.
English Electric Co., Ltd.
Ferranti, Ltd.
Ferranti (Meters), Ltd., Denis
Field Aircraft Services, Ltd.
International Aeradio, Ltd.
McInnes, Ltd., Dobbie
Murphy Radio, Ltd.
Newton and Co., H. T.
Newton Brothers (Derby), Ltd.
Parman Aircraft Supplies, Ltd.
Philips Electrical, Ltd.
Plessey Co., Ltd., The
Rotax, Ltd.
Sanders (Electronics), Ltd., W. H.
Savage, Ltd., W. Bryan
Scottish Distributors, Ltd.
Standard Telephones and Cables, Ltd.
Stewart Aeronautical Supply Co., Ltd.
Walter, A. J.
Whittemore (Aeradio), Ltd., A. J.

WASHERS.—see A.G.S. Parts

WEAPONS, GUIDED.—see Missiles, Guided

WEIGHING EQUIPMENT
Aerocontacts (Ground Equipment), Ltd.
Elliott Brothers (London), Ltd.
International Aeradio, Ltd.
Parsons and Co., Ltd., S.
Philips Electrical, Ltd.
Salter and Co., Ltd., Geo.
Skyhi, Ltd.

WEIGHING SERVICE FOR AIRCRAFT, ETC.
British Aviation Services (Engineering), Ltd.
Derby Aviation, Ltd.
Field Aircraft Services, Ltd.

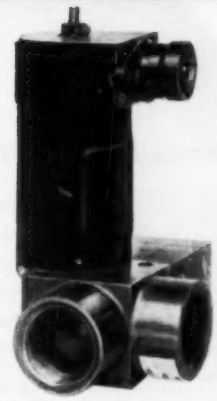
WELDING EQUIPMENT, ELECTRICAL
Aerocontacts (Ground Equipment), Ltd.
Auto Diesels, Ltd.
British Brown-Boveri, Ltd.
British Oxygen Gases, Ltd.
British Thomson-Houston Co., Ltd., The
Burnley Aircraft Products, Ltd.
Eagle Aircraft Services, Ltd.
General Electric Co., Ltd.. The
Murex Welding Processes, Ltd.
Philips Electrical, Ltd.
Quasi-Arc, Ltd.
Sanders (Electronics), Ltd., W. H.
Sciaky Electric Welding Machines, Ltd.
Vernons Industries, Ltd.

WELDING EQUIPMENT, OTHER THAN ELECTRICAL
Aerocontacts (Ground Equipment), Ltd.
British Oxygen Gases, Ltd.
Burnley Aircraft Products, Ltd.
Eagle Aircraft Services, Ltd.
Scottish Distributors, Ltd.

WHEELS, CASTOR, ETC., INDUSTRIAL
Aero Controls, Ltd.
Autoset (Production), Ltd.
Eagle Aircraft Services, Ltd.
Flexello Castors and Wheels, Ltd.

WHEELS, LANDING
Dunlop Rubber Co., Ltd.
Eagle Aircraft Services, Ltd.
Field Aircraft Services, Ltd.
Goodyear Tyre and Rubber Co., (Great Britain), Ltd.
Palmer Tyre, Ltd., The
Parman Aircraft Supplies, Ltd.
Skylines Aircraft Components, Ltd.
Walter, A. J.

WIND TUNNELS AND EQUIPMENT
Airscrew Co., and Jicwood, Ltd., The
British Brown-Boveri, Ltd.
Douglas (Contractors), Ltd., Robt. M.
Harvey and Co. (London), Ltd., G. A.
Morfax, Ltd.
Simmons and Hawker, Ltd.
Test Equipment (Models), Ltd.
Walker (A.D.), Ltd., James
Woodside Die Sinking Co., Ltd.



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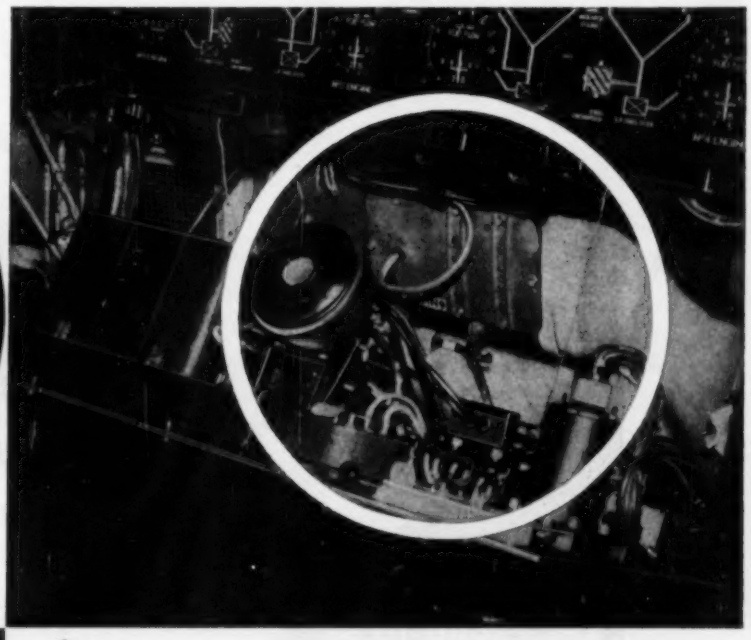

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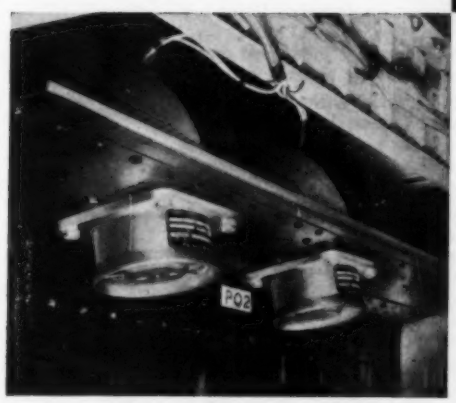

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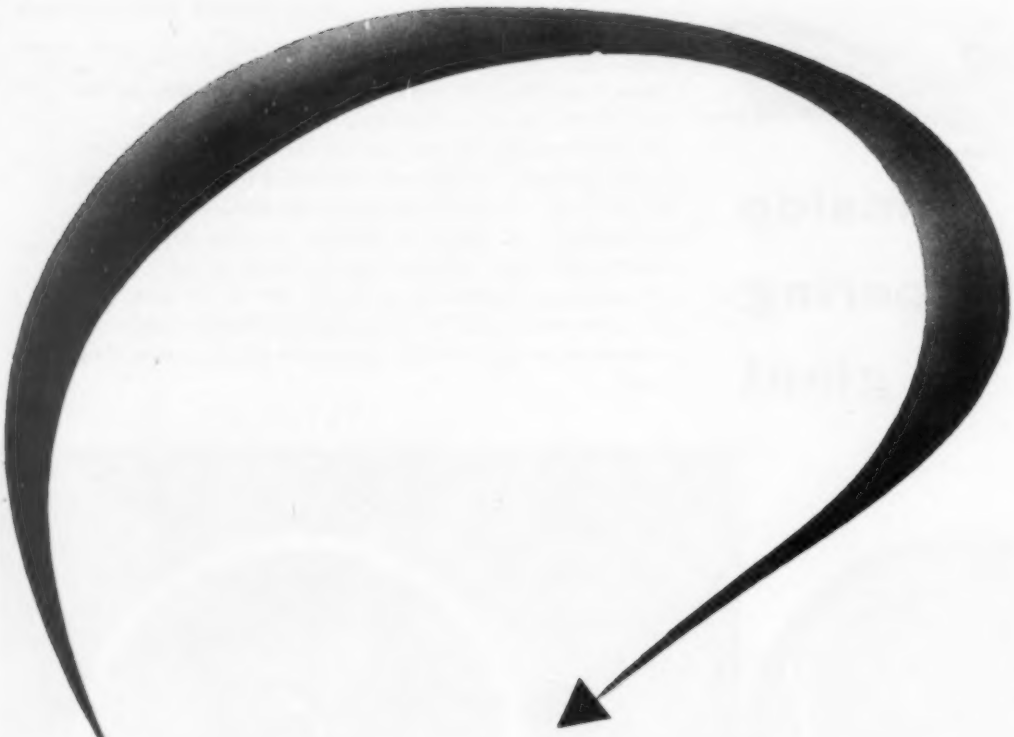

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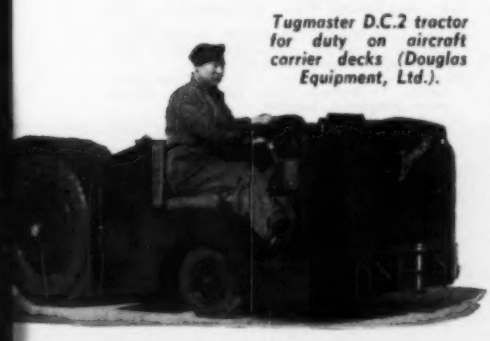

Tugmaster D.C.2 tractor for duty on aircraft carrier decks (Douglas Equipment, Ltd.).

E.P.S. (Research and Development), Ltd., Staplehurst Road, Sittingbourne, Kent. T: Sittingbourne 1313.
E.R.S. (London), Ltd., 159 Brookwood Road, London, S.W.18. T: Putney 3402-4.
Eagle Aircraft Services, Ltd., Blackbushe Airport, Camberley, Surrey. T: Yateley 2371. TA: Eagle, Camberley.
Easco Electrical (Holdings), Ltd., 6/8 Brighton Terrace, London, S.W.9. T: Brixton 4961 (3 lines). TA: Eascoelect, Claproad, London.
Eastern Aero Electrical Services, Ltd., 62 Priory Street, Colchester, Essex. T: Colchester 6173/4 (PBX). TA: Eastaulec.
Eccles (Birmingham), Ltd., Arrow Road, Redditch, Worcs. T: Redditch 3365.
Ekco Electronics, Ltd., Ekco Works, Southend-on-Sea, Essex. T: Southend-on-Sea 49491. TA: Ekco, Southend-on-Sea.
Electro-Hydraulics, Ltd., Liverpool Road, Warrington, Lancs. T: Warrington 35241. TA: Hydraulics, Warrington.
Elliot Equipment, Ltd., Llwynypia, Rhondda, S. Wales. T: Tonypandy 3232. TA: Rescue, Tonypandy.
Elliott Brothers (London), Ltd., Airport Works, Rochester, Kent. T: Chatham 3404.
Engineering Products, Ltd., Littlers Close, Merton Abbey, London, S.W.19. T: Liberty 1085/6. TA: Oldakgauge, Souphone, London.
English Electric Co., Ltd., The, Aircraft Equipment Division, Phoenix Works, Bradford, 3, Yorks. T: Bradford 65221.
English Electric Co., Ltd., The, Guided Weapons Division, Marconi House, Strand, London, W.C.2. T: Covent Garden 1234. TA: Enelectico, Estrand, London.
English Steel Castings Corporation, Ltd., English Steel Forge and Engineering Corporation, Ltd., English Steel Rolling Mills Corporation, Ltd., P.O. Box 57, River Don Works, Sheffield, 9. T: Sheffield 41071. TA: Steelcorpo, Sheffield.
English Steel Tool Corporation, Ltd., North Street Works, Openshaw, Manchester. T: Manchester East 1371. TA: Steelcorpo, Manchester.
Esavian, Ltd., Esavian Works, Stevenage, Herts. T: Stevenage 500. TA: Esavian, Stevenage.
Esso Petroleum Co., Ltd., Aviation Department, 101 Piccadilly, London, W.1. T: Grosvenor 4251. TA: Airesso, Audley.
Exactor, Ltd., Exactor Works, Church Way, Edgware, Middx. T: Edgware 0071-2. TA: Exactor, Phone, Edgware.
Export Packing Service, Ltd., Imperial Buildings, 56 Kingsway, W.C.2. T: Chancery 5121. TA: Expac, Westcent, London.

Faber and Faber, Ltd., 24 Russell Square, London, W.C.1. T: Museum 9543. TA: Fabbaf, Westcent, London.
Fairey Air Surveys, Ltd., 24 Bruton Street, London, W.1. T: Mayfair 8791. TA: Airimap, London.
Fairey Aviation Co., Ltd., The Hayes, Middlesex. T: Hayes 3800. TA: Airily, Telex, London.
Fairey Marine, Ltd., Hamble, Nr. Southampton, Hants. T: Hamble 2135. TA: Fairey Aviation, Hamble, Hants.
Feltham and Son, Ltd., Walter H., Imperial Works, Tower Bridge Road, London, S.E.1. T: Hop 1784 (2 lines). TA: Unbagged, Sedist, London.
Ferranti, Ltd., Hollinwood, Lancashire. T: Failsworth 2000. TA: Ferranti, Hollinwood.
Ferranti (Meters), Ltd., Denis, Caernarvon Road, Bangor, North Wales. T: Bangor 860. TA: Deferranti, Bangor.
Ferro Enamels, Ltd., Wombourne, Wolverhampton. T: Wombourne 2281. TA: Fernam, Wombourne.
Fibreglass, Ltd., Ravenhead, St. Helens, Lancs. T: St. Helens 4224. TA: Fibreglass, St. Helens.
Field Aircraft Services, Ltd., 72 Wigmore Street, London, W.1. T: Welbeck 7799. TA: Fieldair, Wesdo, London.
Fielding and Platt, Ltd., Atlas Works, Gloucester, T: Gloucester 20351. TA: Atlas, Gloucester.
Fireproof Tanks, Ltd., The Airport, Portsmouth. T: Portsmouth 70836/7/8. TA: Fireproof, Portsmouth.
Firestone Tyre and Rubber Co., Ltd., Great West Road, Brentford, Middx. T: Ealing 3456. TA: Firestone, Brentford.
Firth and John Brown, Ltd., Thos., Atlas Works, Sheffield, 4. T: Sheffield 20081. TA: Atlas Sheffield, 4.
Firth and Sons, Ltd., T. F., Flush Mills, Heckmondwike, Yorks. T: Heckmondwike 482-6.
Firth Cleveland Instruments, Ltd., Byron House, 7-9 St. James's Street, London, S.W.1. T: Whitehall 5772. TA: Aerocession, London.
Firth-Derihon Stampings, Ltd., The, Sheffield Road, Tinsley, Sheffield, 9. T: Sheffield 42051. TA: Derihon, Sheffield.
Firth-Vickers Stainless Steels, Ltd., Weedon Street, Tinsley, Sheffield, 9. T: Sheffield 42051. TA: Staybrite, Sheffield.
Fischer Bearings Co., Ltd., Upper Villiers Street, Wolverhampton. T: Wolverhampton 26101-8. TA: Hirev, Wolverhampton.
Fishers', 86/88 Wellington Street, Woolwich, London, S.E.18. T: Woolwich 1055. TA: Fishers', Woolwich.
Flather, Ltd., W. T., Standard Steel Works, Tinsley, Sheffield, 9. T: Attercliffe 41152. TA: Flather, Phone, Sheffield.
Flexello Castors and Wheels, Ltd., Slough, Bucks. T: Slough 24121. TA: Flexello, Slough.
Flexible Drives (Gilmans), Ltd., 195 High Street, Smethwick, 41, Staffs. T: Smethwick 1202. TA: Skatoskalo, Phone, Birmingham.
Flight Equipment and Engineering, Ltd., 163/169 Brompton Road, London, S.W.3. T: Kensington 3698. TA: Flitequip, London.
Flight Refuelling, Ltd., Tarrant Rushton, Blandford, Dorset. T: Blandford 501. TA: Refuelling, Blandford.
Flint, Ltd., Howard, 18 Grosvenor Street, London, W.1. T: Mayfair 3282.
Foamite, Ltd., 235-241 Regent Street, London, W.1. T: Regent 6527. TA: Wesdo, London.
Foldex, Ltd., 45 Mitchell Street, London, E.C.1. T: Clerkenwell 0711. TA: Foldexlon.
Folland Aircraft, Ltd., Sydney Lodge, Hamble, Southampton, Hampshire. T: Hamble 3191 (13 lines). TA: Follair, Hamble.
Fonadek (Branson), Ltd., Knightsdowne House, Vivian Road, Birmingham 17. T: Harborne 2267-8. TA: Fonadek, Birmingham.
Fothergill and Harvey (Sales), Ltd., Harvester House, Peter Street, Manchester, 2. T: Blackfriars 3232. TA: Harvester, Manchester.
Fox and Co., Ltd., Samuel, Stocksbridge Works, nr., Sheffield. T: Sheffield 40871. TA: Fox, Deepcar.
Frankenstein and Sons (Manchester), Ltd., P., Victoria Rubber Works, Newton Heath, Manchester, 10. T: Failsworth 1166. TA: Proofing, Manchester, 10.
French and Sons, Ltd., Thomas, Dundas House, 59 St. James's Street, London, S.W.1. T: Hyde Park 0093.

G.Q. Parachute Co., Ltd., Stadium Works, Portugal Road, Woking, Surrey. T: Woking 2277. TA: Parachutes, Woking.
Gabriel Manufacturing Co., Ltd., Newton Road, Torquay, Devon. T: Kingkerswell 2174.
Garringtons, Ltd., Newton Works, Bromsgrove, Worcs. T: Bromsgrove 2621. TA: Garrington, Phone, Bromsgrove.
Gear Grinding Co., Ltd., The, Cranmore Boulevard, Shirley, Birmingham. T: Shirley 2231. TA: Orcutt, Birmingham.
General Electric Co., Ltd., The, Magnet House, Kingsway, London, W.C.2. T: Temple Bar 8000 (Ex. 218 or 321). TA: Electricity, Westcent, London.
General Fire Appliance Co., Ltd., St. Florian House, 3 George Street, Croydon, Surrey. T: Croydon 2273. TA: Firgenap, Croydon.
Gieves, Ltd., 27 Old Bond Street, London, W.1. T: Hyde Park 2276. TA: Muftis, Piccy, London.
Girling, Ltd., Kings Road, Tyseley, Birmingham 11. T: Acocks Green 2831. TA: Wonder, Birmingham.
Gloster Engineering (Cheltenham), Ltd., 30 St. Paul's Street North, Cheltenham, Glos. T: Cheltenham 54779.
Godfrey Engineering Co., Ltd., 23-29 Green Lane, Birmingham 9.
Godfrey and Partners, Ltd., Sir George, Hampton Road West, Hanworth, Middx. T: Feltham 3291-7. TA: Godfrepart, London.
Goodmans Industries, Ltd., Axiom Works, Wembley, Middx. T: Wembley 1200 (9 lines). TA: Goodaxiom, Wembley.
Goodyear Tyre and Rubber Co. (Great Britain), Ltd., The, Bushbury, Wolverhampton, Staffordshire. T: Wolverhampton 22321. TA: Gotyruco, Wolverhampton.
Gosheron and Co., Ltd., John, 79-81 Albert Embankment, Vauxhall, London, S.E.11. T: Reliance 7600-9. TA: Gosheronic, London, S.E.11.
Graseby Instruments, Ltd., Kingston By-pass Road, Tolworth, Surrey. T: Elmbridge 5742/3.
Graviner Manufacturing Co., Ltd., Poyle Mill Works, Colnbrook, Bucks. T: Colnbrook 48/49. TA: Crashfires, Colnbrook.
Guest, Keen and Nettlefolds (Midlands), Ltd., Box No. 24, Heath Street, Birmingham 18. T: Smethwick 1441. TA: Nettlefolds, Birmingham 18.

H. and F. Precise Castings, Ltd., Ascot Drive, Derby. T: Derby 40481. TA: Accuracy, Derby.
H.M.L. (Engineering), Ltd., 466/490, Edgware Road, London, W.2. T: Paddington 0022.
Habershon and Sons, Ltd., J. J., Holmes Mills, Rotherham. T: Rotherham 2081. TA: Habershon, Sons, Rotherham.
Hadfields, Ltd., East Hecla Works, Sheffield 9. T: Sheffield 41001. TA: Hadfield, Sheffield.
Hairlok Co., Ltd., The, Magna Works, Kathie Road, Bedford. T: Bedford 4271. TA: Bedford 4271.
Hall and Hall, Ltd., Oldfield Works, Hampton, Middlesex. T: Molesey 2180. TA: Hallite, Hampton, Middx.
Hall and Pickles, Ltd., Port Street, Manchester 1. T: Manchester Central 4571. TA: Iron, Manchester.
Hall and Sons (Bristol and London), Ltd., John, 1/5 St. Pancras Way, London, N.W.1. T: Euston 2262. TA: John Hall, Norwest, London.
Hants and Sussex Aviation, Ltd., and Hants and Sussex Aviation Contractors, Ltd., The Airport, Portsmouth. T: Portsmouth 73947. TA: Portsmouth 73947.

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Aircraft fuel meter (George Kent, Ltd.).

Hardy Spicer, Ltd., Birch Road, Witton, Birmingham 6. T: Birchfields 4504-9. TA: Autojoints, Birmingham 6.
Harley Aircraft Landing Lamps, Paxton Hill, St. Neots, Hunts. T: St. Neots 230-231. TA: Harley, St. Neots.
Harringay Photographic and Electrical Supplies, Ltd., 423 Green Lanes, London, N.4. T: Mountview 5241.
Harvey and Co. (London), Ltd., G. A., Woolwich Road, London, S.E.7. T: Greenwich 3232. TA: Cheaper, Wol, London.
Hawksley S.M.D., Ltd., Buckingham Avenue, Slough, Bucks. T: Slough 23212. TA: Alframe, Slough.
Headland, Ltd., Thos. P., No. 10 Melon Road, Peckham, London, S.E.15. T: New Cross 4300. TA: Teepaitch, London.
Heenan and Froude, Ltd., Worcester Engineering Works, Worcester. T: Worcester 3461 (8 lines). TA: Heenan, Worcester.
Hellermann, Ltd., Gatwick Road, Crawley, Sussex. T: Crawley 2000/1/2/3/4. TA: Hellermann, Crawley.
Helliwells, Ltd., Birmingham Airport, Birmingham 26. T: Sheldon 2630-39. TA: Helliwells, Birmingham 26.
Henderson Safety Tank Co., Ltd., The, 2 Elstree Way, Boreham Wood, Herts. T: Elstree 1758. TA: Hencorite, Boreham Wood.
Hendrey Relays, Ltd., 392 Bath Road, Slough. T: Burnham 609/610.
Henley's Telegraph Works Co., Ltd., W. T., 51-53 Hatton Garden, London, E.C.1. T: Chancery 6822. TA: Henletel, Cent, London.
Henshall and Sons (Addlestone), Ltd., W., Abbott Close, Oyster Lane, Byfleet, Surrey. T: Byfleet 2227-8. TA: Hentone.
Hepworth and Grandage (Yeadon), Ltd., Harrogate Road, Yeadon, Leeds, Yorks. T: Rawdon 1225/6.
Heston Aircraft and Associated Engineers, Ltd., The, Heston Airport, Hounslow, Middx. T: Hayes 3844. TA: Hestairco, Phone, Hounslow.
High Duty Alloys, Ltd., Slough, Buckinghamshire. T: Slough 23901. TA: Alloys, Slough.
High-Pressure Components, Ltd., Sunflex Works, Colham Mill Road, West Drayton, Middx. T: West Drayton 2226/7. TA: Gyponent, West Drayton.
Hobson, Ltd., H. M., Hobson Works, Fordhouses, Wolverhampton, Staffs. T: Fordhouses 2266. TA: Accuracy, Wolverhampton.
Honeywell-Brown, Ltd., 1 Wandsworth Road, Perivale, Greenford, Middlesex. T: Perivale 5691. TA: Minnreg, Greenford.
Hordern Richmond (Sales), Ltd., Hy-du-lignum Works, Haddenham, Aylesbury, Bucks. T: Haddenham 444. TA: Winstix, Aylesbury.
Hughes Engineering Co. (Leicester), Ltd., Noble Works, Briton Street, Leicester. T: Leicester Granby 1481-2.
Hughes-Johnson Stampings, Ltd., The, Langley Green, Birmingham. T: Broadwell 1361. TA: Engines, Langley, Worcs.
Hunting Aerosurveys, Ltd., 6 Elstree Way, Boreham Wood, Herts. T: Elstree 2214. TA: Astereo, Boreham Wood.
Hymatic Engineering Co., Ltd., The, Glover Street, Redditch, Worcs. T: Redditch 743. TA: Hymatic, Redditch.

I.V. Pressure Controllers, Ltd., Atlas House, 683 London Road, Isleworth, Middlesex. T: Hounslow 7273/4/5. TA: Ivee Press, Hounslow.
Ilford, Ltd., Ilford, Essex. T: Ilford 3000. TA: Plates, Ilford.
Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. T: Waterloo 3333. TA: Iliffepres, Sedist, London.
Imperial Chemical Industries, Ltd., Imperial Chemical House, Millbank, London, S.W.1. T: Victoria 4444. TA: Impkemix, Telex, London.
Integral, Ltd., Birmingham Road, Wolverhampton. T: Wolverhampton 24984.
International Aeradio, Ltd., 40 Park Street, London, W.1. T: Hyde Park 5024. TA: Intaerio, Audley, London.
Irving Air Chute of Great Britain, Ltd., Letchworth, Herts. T: Letchworth 888. TA: Irvin, Letchworth.
Irwin and Partners, Ltd., E. G., Burton House, High Street, Bracknell, Berks. T: Bracknell 376.

Jablo Plastics Industries, Ltd., and Jablo Propellers, Ltd., Waddon, Croydon, Surrey. T: Croydon 2201. TA: Jablo, Croydon.
Jameson, Ltd., J. L., West Street Works, Ewell, Surrey. T: Ewell 4747-50. TA: Jameson, Ewell, Surrey.
Jenks Brothers, Ltd., Britool Works, Bushbury, Wolverhampton. T: Wolverhampton 31281. TA: Jenbro, Wolverhampton.
Jessop and Sons, Ltd., William, Brightside Works, Sheffield 9. T: 41352/9. TA: Jessop, Sheffield 9.
Jet Tanks, Scottish Union House, 25 Bucklersbury, London, E.C.4.
Jig Design and Engineering Co., 27-28a High Street, Windsor, Berks. T: Windsor 2171.

K.L.G. Sparking Plugs, Ltd., Putney Vale, London, S.W.15. T: Putney 8111.
Kautex, Ltd., Elstree Way, Elstree, Herts. T: Elstree 1777/8/9. TA: Kautex, Borehamwood.
Kaye, Ltd., E. and B., Queensway, Ponders End, Enfield, Middx. T: Howard 1601. TA: Cuwire, Enfield.
Kayser, Ellison and Co., Ltd., Carlisle Steel Works, Carlisle Street, Sheffield 4. T: Sheffield 22124. TA: Kayser, Sheffield 4.
Kelvin and Hughes, Ltd., New North Road, Barkingside, Ilford, Essex. T: Hainault 2601. TA: Husun, Barkingside.
Kelvin and Hughes (Aviation), Ltd., Winchester Road, Basingstoke, Hants. T: Basingstoke 690. TA: Kelbaird.
Kenilworth Manufacturing Co., Ltd., The, Hermetite Works, West Drayton, Middx. T: West Drayton 3047. TA: Usefulness, West Drayton.
Kent Alloys, Ltd., Temple Manor Works, Rochester, Kent. T: Strood 7674-7. TA: Alloys, Rochester.
Kent, Ltd., George, Biscot Road, Luton, Beds. T: Luton 2440. TA: Kents, Luton.
Kidde Co., Ltd., The Walter, Lux Works, Belvue Road, Northolt, Middlesex. T: Waxlow 1061. TA: Luxtector, London.
Kilfrost, Ltd., 20 Saville Row, Newcastle-upon-Tyne 1. T: Newcastle 20448-9. TA: Kilfrost, Newcastle-upon-Tyne.
King Aircraft Corporation, Cameron Street, Hillington, Glasgow, S.W.2. T: Halfway 4571. TA: Aircraft, Glasgow.
Kiveton Park Steel and Wire Works, Ltd., Kiveton Park, Nr. Sheffield. T: Kiveton 252. TA: Brightalloy, Phone, Kiveton.
Kodak, Ltd., Kodak House, Kingsway, London, W.C.2. T: Holborn 7841. TA: Kodak, Westcent, London.

Lacy-Hulbert and Co., Ltd., Boreas Works, Beddington, Nr. Croydon, Surrey. T: Croydon 5504/7. TA: Percussive, Croydon.
Lancefield Aircraft Components, Ltd., Herries Street, London, W.10. T: Ladbroke 2951-4. TA: Lancefield, Ladbroke 2951.
Laporte Chemicals, Ltd., Kingsway Works, Luton, Bedfordshire. T: Luton 4390. TA: Laporte, Luton.
Latex Upholstery, Ltd., 41 Lonsdale Road, London, W.11. T: Bayswater 6262-6.
Laycock Engineering, Ltd., Victoria Works, Millhouses, Sheffield 8. T: Sheffield 74411. TA: Invention, Sheffield.
Lea Bridge Industries, Ltd., Priory Works, Arterial Road, Southend-on-Sea, Essex. T: Eastwood 55265-8. TA: Freedom, Southend.
Lep Transport, Ltd., Sunlight Wharf, Upper Thames Street, London, E.C.4. T: Central 5050. TA: Depolep, London.
Lewis, D., Ltd., 124 Gt. Portland Street, London, W.1. T: Museum 4314. TA: Aviakit, Wesdo, London.
Leytonstone Jig and Tool Co., Ltd., Leytool Works, High Road, Leyton, London, E.10. T: Leytonstone 5022. TA: Leytool, Leystone.
Light Engineering Designs (Gosport), Ltd., Priory Road, Hardway, Gosport, Hants. T: Gosport 88081-3.
Light Soldering Developments, Ltd., 106 George Street, Croydon, Surrey. T: Croydon 8589. TA: Litesold, Croydon.
Lion Electronic Developments, Ltd., Lion Works, Hanworth Trading Estate, Feltham, Middx. T: Feltham 6661.
Lockheed Hydraulic Brake Co., Ltd., Tachbrook Road, Leamington Spa, Warwicks. T: Leamington Spa 2700. TA: Lockheed, Leamington Spa.
Lodge Plugs, Ltd., St. Peter's Road, Rugby, Warwickshire. T: Rugby 2076. TA: Lodge, Rugby.
London Name Plate Manufacturing Co., Ltd., The, Zylo Works, Brighton 7. T: Brighton 27025. TA: Zylo, Brighton.
Long and Hambly, Ltd., Slater Street, High Wycombe, Bucks. T: High Wycombe 2321. TA: Longhamb, High Wycombe.
Low Moor Alloy Steelworks, Ltd., Low Moor, Bradford, Yorkshire. T: Bradford 77331. TA: Steeloy, Low Moor.
Low Moor Fine Steels, Ltd., The Steelworks, Low Moor, Bradford, Yorks. T: Bradford 77330. TA: Steeloy, Low Moor.
Lucas (Batteries), Ltd., Joseph, Great King Street, Birmingham 19. T: Northern 5252. TA: Lucas, Telex, Birmingham.
Lucas (Gas Turbine Equipment), Ltd., Joseph, Shaftmoor Lane, Birmingham, 28, Warwickshire. T: Springfield 3232. TA: Luset, Birmingham.
Lusifell Products, Ltd., St. Margarets Lane, Titchfield, Hants. T: Titchfield 2284.

M.H.H. Engineering Co., Ltd., Gosden Common, Bramley, Guildford, Surrey. T: Bramley 2248.
M.L. Aviation Co., Ltd., White Waltham, Maidenhead, Berks. T: Littlewick Green 248. TA: Emelair, White Waltham.
McInnes, Ltd., Dobbie, Broomloan Road, Glasgow, S.W.1. T: Govan 2394. TA: Compass, Glasgow.
McMichael Radio, Ltd., Bedford Avenue, Trading Estate, Slough, Bucks. T: Slough 24007.
Magnesium Elektron, Ltd., P.O. Box 6, Clifton Junction, Swinton, Manchester. T: Swinton 2511. TA: Magneselek, Phone, Manchester.
Mallock-Armstrong Co., The, 204 High Street, Guildford, Surrey. T: Guildford 66488.
Manchester Oil Refinery (Sales), Ltd., Twining Road, Trafford Park, Manchester 17. T: Trafford Park 0218/9. TA: Refinery, Eccles, Manchester.
Marconi Instruments, Ltd., Longacres, St. Albans, Herts. T: St. Albans 56161. TA: Measurtest, St. Albans.
Marconi's Wireless Telegraph Co., Ltd., New Street, Chelmsford, Essex. T: Chelmsford 3221. TA: Expanse, Chelmsford.
Maricon, Ltd., Oldfield Road, Hampton, Middx. T: Molesey 2180. TA: Maricon, Hampton, Middx.
Marston Excelsior, Ltd., Wobaston Road, Fordhouses, Wolverhampton. T: Fordhouses 3361. TA: Icimarex, Telex, Wolverhampton.
Martin-Baker Aircraft Co., Ltd., Higher Denham, Nr. Uxbridge, Middlesex. T: Denham 2214. TA: Ejections, Uxbridge.
Measuring Instruments (Pullin), Ltd., Electrin Works, Winchester Street, Acton, London, W.3. T: Acorn 4651-3. TA: Mipullco, Ealux, London.
Mechanism, Ltd., Gyro Works, George Street, Croydon, Surrey. T: Croydon 3426-9. TA: Gyromec, Croydon.
Mercury Truck and Tractor Co., Ltd., The, The Quay, Gloucester. T: Gloucester 24451. TA: Mercury, Gloucester.
Meridian Airmaps, Ltd., Shoreham Airport, Sussex. T: Shoreham by Sea 2366.
Metal Gravure Co., Ltd., The, Babington Works, 151a Knollys Road, Streatham, S.W.16. T: Streatham 2171-3.
Microcell, Ltd., Imperial Buildings, 56 Kingsway, London, W.C.2. T: Chancery 3424. TA: Microcell, Westcent, London.
Miles, Ltd., F. G., Shoreham Airport, Sussex. T: Shoreham 2301. TA: Miles, Shoreham Airport.
Miles Structural Plastics, Ltd., Regal Works, Penhill Road, Lancing, Sussex. T: Lancing 2429.
Miller Aviation, Ltd., Adastral House, Lowfield Heath, Crawley, Sussex. T: Horley 4300. TA: Millspares, Crawley.
Mining and Chemical Products, Ltd., 86 Strand, London, W.C.2. T: Covent Garden 3393. TA: Minchepro, Rand, London.
Minnesota Mining and Manufacturing Co., Ltd., Ardern Road, Adderley Park, Birmingham 8. T: East 2051. TA: Minnesota, Birmingham.
Mobil Oil Co., Ltd., Caxton House, London, S.W.1. T: Whitehall 1010. TA: Mobiloil, London, Telex.
Modern Industrial Finishes, Ltd., Thames Chemical Works, Lower Road, Northfleet, Gravesend, Kent. T: Greenhithe 3171. TA: Modfin, Gravesend.
Mollart Engineering Co., Ltd., The, Kingston By-Pass, Surbiton, Surrey. T: Elmbridge 0033-7. TA: Precision, Surbiton.
Mond Nickel Co., Ltd., The, Thames House, Millbank, Westminster, S.W.1. T: Victoria 3888. TA: Nictatio, Telex, London.
Morfax, Ltd., Willow Lane, Mitcham, Surrey. T: Mitcham 4525.
Morris, Ltd., B. O., Morrisflex Works, Briton Road, Coventry, Warwickshire. T: Coventry 5081. TA: Morisflex, Coventry.
Motor Components (Birmingham), Ltd., Burbridge Road, Bordesley Green, Birmingham 9. T: Birmingham, Victoria 0514. TA: Valvanring, Birmingham.
Muirhead and Co., Ltd., Beckenham, Kent. T: Beckenham 0041. TA: Muirhead, Beckenham.
Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2. T: Gerrard 7777. TA: Mullectron.
Munro, Ltd., R. W., Cline Road, Bounds Green, London, N.11. T: Enterprise 4422-3. TA: Munrengic, Phone, London.
Murex Welding Processes, Ltd., Waltham Cross, Herts. T: Waltham Cross 3636. TA: Murexweld, Norphone, London.
Murphy Radio, Ltd., Electronics Division, Broadwater Road, Welwyn Garden City, Hertfordshire. T: Welwyn Garden 3434. TA: Radmurphy.

Napier and Son, Ltd., D., 211 The Vale, London, W.3. T: Shepherds Bush 1220. TA: Moneyer, Telex, London.
Negretti and Zambra, Ltd., 122 Regent Street, London, W.1. T: Regent 3406. TA: Negretti, Piccy, London.

Newman Industries, Ltd., Springfield Road, Grantham, Lincs. T: Grantham 1313.
Newmark, Ltd., Louis, Prefect Works, 542/548 Purley Way, Croydon, Surrey. T: Croydon 5571. TA: Newmark, Croydon.
Newton and Co., H. T., Gatwick Airport, Horley, Surrey. T: Horley 3613 and Horley 1510. TA: Newtonair.
Newton and Co., Ltd., L. H., Nechells, Birmingham 7. T: East 1551. TA: Bolanut, Telex, Birmingham.
Newton Brothers (Derby), Ltd., Alfreton Road, Derby. T: Derby 47676 (4 lines). TA: Dynamo, Derby.
Normalair, Ltd., Yeovil, Somerset. T: Yeovil 1100. TA: Normalair, Yeovil.
Northern Aluminium Co., Ltd., Bush House, Aldwych, London, W.C.2. T: Temple Bar 8430. TA: Noraluco, Estrand, London.
North West Machine Design Co., Ltd., 177 Kenton Road, Kenton, Mddx. T: Wordsworth 0301.

Oddie, Bradbury and Cull, Ltd., Portswood Road, Southampton, Hants. T: Southampton 55883. TA: Fasteners, Southampton.
Oil Feed Engineering Co., Ltd., 18 Denbigh Street, London, S.W.1. T: Victoria 9807-9. TA: Hiflex, Souwest, London.
Oldham and Son, Ltd., Hyde Road, Denton, Manchester. T: Denton 2431. TA: Oldhams, Denton, Manchester.
Omes, Ltd., Beverley Works, Barnes, London, S.W.13. T: Prospect 2291. TA: Omesheatly, Put, London.
Opperman, Ltd., S. E., Stuart Works, Stirling Corner, Boreham Wood, Herts. T: Elstree 2021 TA: Gearcut, Boreham Wood.
Optical Measuring Tools, Ltd., Oldfield House, 142 Bridge Road, Maidenhead, Berks. T: Maidenhead 3704-5-6. TA: Optool, Maidenhead.

Palmer Tyre, Ltd., The, Herga House, Vincent Square, London, S.W.1. T: Victoria 8323. TA: Palmertyr, Telex, London.
Park, Ltd., R. and J., Dominion Works, Thames Road, Chiswick, London, W.4. T: Chiswick 7761. TA: Parkdomin, Chisk.
Parman Aircraft Supplies, Ltd., Parman House, Balcombe Road, Horley, Surrey. T: Horley 4344. TA: Parmanair, Horley.
Parnall and Co., Ltd., George, The Causeway, Fishponds, Bristol. T: Bristol 54271-2. TA: Fittings, Bristol.
Parsons and Co., Ltd., S., Young Street, Bradford, Yorks. T: Bradford 45494. TA: Parweigh, Bradford.
Partridge, Wilson and Co., Ltd., Davenset Electrical Works, Evington Valley Road, Leicester. T: Leicester 37291. TA: Davenset, Leicester.
Peradin and Watercraft, Ltd., Freshford, nr. Bath, Somerset. T: Limpley Stoke 3263. TA: Peradin, Bath.
Perry Barr Metal Co., Ltd., Shady Lane, Great Barr, Birmingham 22a. T: Great Barr 1794-6. TA: Perbarmet, Birmingham.
Petbow, Ltd., Sandwich, Kent. T: Sandwich 3311. TA: Petbowld, Sandwich.
Peto and Radford, Ltd., 137 Victoria Street, London, S.W.1. T: Tate Gallery 9212. TA: Dagenite, Sowest, London.
Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2. T: Gerrard 7777. TA: Phillamps, Phone, London.
Phosphor Bronze Co., Ltd., The, Bradford Street, Birmingham, 5. T: Midland 6621. TA: Iffiest, Birmingham.
Pipework and Engineering (Bristol), Ltd., Stanley Street South, Bedminster, Bristol, 3. T: Bristol 61901. TA: Pipework, Bristol.
Pitman and Sons, Ltd., Sir Isaac, 39-41 Parker Street, London, W.C.2. T: Holborn 9791. TA: Ipandsons, Westcent, London.
Plannair, Ltd., Windfield House, Leatherhead, Surrey. T: Leatherhead 4091-3. TA: Plannair, Leatherhead.
Plessey Group of Companies, The, Vicarage Lane, Ilford, Essex. T: Ilford 3040. TA: Plessey, Ilford.
Portsmouth Aviation, Ltd., The Airport, Portsmouth, Hants. T: Portsmouth 70374. TA: Balmurlux, Portsmouth.
Power Auxiliaries, Ltd., Kembrey Street, Swindon, Wilts. T: Swindon 5461.
Power Jets (Research and Development), Ltd., 25 Green Street, London, W.1. T: Mayfair 7801. TA: Reactors, Audley, London.
Powis and Sons, Ltd., David, Forward Works, Golden Hillock Road, Sparkbrook, Birmingham 11. T: Victoria 1264. TA: Powis, Birmingham.
Precision Rubbers, Ltd., Bagworth, Leicestershire. T: Bagworth 241/2. TA: Rubbers, Bagworth.
Pullin and Co., Ltd., R. B., Phoenix Works, Great West Road, Brentford, Middx. T: Ealing 0011-3 and 3661-5. TA: Pullinco, Wesphone, London.
Pulsometer Engineering Co., Ltd., The, Nine Elms Ironworks, Reading, Berks. T: Reading 67182/3/4/5. TA: Pulsometer, Readnig.
Purefoy Unit Tooling, Ltd., J. B., Upper Tilt Works, Cobham, Surrey. T: Cobham, Surrey 3013. TA: Purefoy, Cobham, Leatherhead.
Pye, Ltd., Radio Works, Cambridge. T: Cambridge 58985. TA: Pyrad, Cambridge.
Pye Telecommunications, Ltd., Newmarket Road, Cambridge. T: Teversham 3131. TA: Pyetelecom, Cambridge.
Pyrene Co., Ltd., The, Great West Road, Brentford, Middlesex. T: Ealing 3444. TA: Pyrene, Brentford.

Quasi-Arc, Ltd., Bilston, Staffs. T: Bilston 41714. TA: Quazarc, Bilston.

R.P.R. Patents, Ltd., Alexandra Palace Station, London, N.10. T: Tudor 2691. TA: Sempun, London, N.W.4.
R.F.D. Co., Ltd., Catteshall Lane, Godalming, Surrey. Godalming 1441. TA: Airships, Godalming.
Racal Engineering, Ltd., Western Road, Bracknell, Berkshire. T: Bracknell 941. TA: Racal, Bracknell, Berks.
Ransome and Marles Bearing Co., Ltd., Newark-on-Trent. T: Newark 456 (8 lines). TA: Bearings, Newark, Telex.
Rapp, Ltd., Leo, 60a Purley Avenue, Cricklewood, N.W.2. T: Gladstone 6393. TA: Metalrapps.
Ratcliffe (Rochdale), Ltd., F. S., Crawford Spring Works, Norman Road, Rochdale, Lancs. T: Rochdale 4692. TA: Recoil, Rochdale.
Ravensbourne Metal Co., Ltd., 34 Bushey Way, Beckenham, Kent. T: Beckenham 5975.
Rawlplug Co., Ltd., The, Rawlplug House, Cromwell Road, London, S.W.7. T: Frobisher 8111. TA: Rawlplug, Southkens.
Redifon, Ltd., Broomhill Road, Wandsworth, London, S.W.18. T: Vandyke 7281. TA: Redifon, Put, London.
Redwing, Ltd., Bensham Works, Bensham Lane, Thornton Heath, Croydon. T: Thornton Heath 3663. TA: Redwing, Croydon.
Regent Oil Co., Ltd., 117 Park Street, London, W.1. T: Mayfair 8474. TA: Biregent, Audley, London.
Reid and Sigrist, Ltd., Braunstone Works, Hinckley Road, Braunstone, Leicester. T: Leicester 88101/2/3/4. TA: Reidsig, Leicester.
Reilly Engineering, Ltd., Pilot Works, Walnut Tree Close, Guildford, Surrey. T: Guildford 67201. TA: Servomatic, Guildford.
Reliance Electrical Wire Co., Ltd., The, Staffa Road, Leyton, London, E.10. T: Leytonstone 3620. TA: Cablekords, Leytonstone, London.
Rellumit (London), Ltd., Chandos House, Palmer Street, London, S.W.1. T: Abbey 3404. TA: Rellumit, Souwest, London.
Renold Chains, Ltd., Renold House, Wythenshawe, Manchester. T: Gatley 5221. TA: Driving, Telex, Manchester.
Reynolds (Packaging), Ltd., Alfred's Way, Barking, Essex. T: Rippleway 3586-9.
Reynolds Tube Co., Ltd., Hay Hall Works, Tyseley, Birmingham, 11. T: Acocks Green 3333. TA: Butted, Birmingham.
Rollason Aerocessories, Ltd., Croydon Airport, Croydon, Surrey. T: Croydon 7238. TA: Rollaccess, Croydon.
Rollason Aircraft and Engines, Ltd., Croydon Airport, Croydon, Surrey. T: Croydon 5151/4. TA: Rollair, Croydon.
Rollet and Co., Ltd., H., 6 Chesham Place, London, S.W.1. T: Sloane 3463. TA: Knonferous, Wesphone, London.
Rose Brothers (Gainsborough), Ltd., Albion Works, Gainsborough, Lincs. T: Gainsborough 2231. TA: Rose, Telex, Gainsborough.
Ross, Courtney and Co., Ltd., Ashbrook Road, Upper Holloway, London, N.19. T: Archway 1166. TA: Homonyms, Holway, London.
Ross, Ltd., S. Grahame, Quarry Lane Works, Whyke, Chichester, Sussex. T: Chichester 2453. TA: Ross, Chichester 2453.
Rotax, Ltd., Chandos Road, Willesden Junction, London, N.W.10. T: Elgar 7777. TA: Rodynalite, London.
Rotol, Ltd., Cheltenham Road, Gloucester. T: Gloucester 24431. TA: Rotol, Gloucester.
Rover Gas Turbines, Ltd., Meteor Works, Lode Lane, Solihull, Warwickshire. T: Sheldon 4242. TA: Roverturbo.
Rozalex, Ltd., 10 Norfolk Street, Manchester, 2. T: Blackfriars 1122/4. TA: Blackfriars 1122/4.
Rubery Owen and Co., Ltd., P.O., Box No. 10, Darlaston, Wednesbury, Staffs. T: James Bridge 3131. TA: Ruberowen, Telex, Darlaston.
Rumbold, L. A. and Co., Ltd., Kingsgate Place, Kilburn, N.W.6. T: Maida Vale 7366/7/8. TA: Rumboldair, Kilb, London.
Rushton Engineering Co., Ltd., 237 Acton Lane, Chiswick, London, W.4. T: Chiswick 6974/5.

Saben, Hart and Partners, Ltd., Electrin House, 93-97 New Cavendish Street, London, W.1. T: Langham 6395.
Salford Electrical Instruments, Ltd., Peel Works, Silk Street, Salford, 3, Lancs. T: Blackfriars (Manchester) 6688. TA: Sparkless, Manchester.
Salter and Co., Ltd., Geo., West Bromwich, Staffs. T: West Bromwich 1855. TA: Salters, West Bromwich, Telex.
Samlesbury Engineering, Ltd., Samlesbury Airfield, Samlesbury, Nr. Blackburn, Lancs. T: Blackburn 44668. TA: Blackburn, Crofilte.
Sanders (Electronics), Ltd., W. H., Gunnels Wood Road, Stevenage, Herts. T: Stevenage 981-2-3. TA: Sandelect, Stevenage.
Sandwell Casting Co., The, Bank Street Foundry, West Bromwich, Staffs. T: Stone Cross 2231-2-3-4. TA: Repcast, West Bromwich.
Sangamo Weston, Ltd., Great Cambridge Road, Enfield, Middlesex. T: Enfield 3434. TA: Sanwest, Enfield.
Sankey and Sons, Ltd., Joseph, Albert Street Works, Bilston, Staffordshire. T: Bilston (Staffs) 41161. TA: Sankey, Bilston.
Saro Laminated Wood Products, Ltd., Folly Works, Whippingham, nr. East Cowes, Isle of Wight. T: Cowes 704. TA: Saroply, East Cowes.
Saunders-Roe, Ltd., Osborne, East Cowes, Isle of Wight. T: Cowes 2211. TA: Saroplane, East Cowes.
Saunders Valve Co., Ltd., Aircraft Division, Blackfriars Street, Hereford. T: Hereford 3125-8. TA: Saunval, Hereford.
Savage, Ltd., W. Bryan, 17 Stratton Street, London, W.1. T: Grosvenor 1926. TA: Decibel, Phone, London.
Schermuly Pistol Rocket Apparatus, Ltd., The, 51 Coleman Street, London, E.C.2. T: Monarch 9307. TA: Spra, Stock, London.
Sciaky Electric Welding Machines, Ltd., Falmouth Road, Slough, Bucks. T: Slough 25551. TA: Sciakyweld, Slough.
Scotney, Ltd., Tom M., St. Ives, Huntingdon. T: St. Ives 2421. TA: Scotney, St. Ives, Hunts.
Scottish Aviation, Ltd., Prestwick Airport, Ayrshire, Scotland. T: Prestwick 79888. TA: Aeronautics, Prestwick.
Scottish Distributors, Ltd., Aeronautical and Scientific Division, 62 Shirland Road, London, W.9. TA: Scodil, London, W.9.
Self-Priming Pump and Engineering Co., Ltd., Edinburgh Avenue, Trading Estate, Slough, Bucks. T: Slough 23277. TA: Priming, Slough.
Serck Radiators, Ltd., Warwick Road, Birmingham, 11. T: (Birmingham) Victoria 4353. TA: Serckrad, Birmingham.
Severn-Lamb, The Fold, Stratford-on-Avon, Warwicks. T: Stratford-on-Avon 3878.
Shackleton, W. S., Ltd., 175 Piccadilly, London, W.1. T: Hyde Park 2448/9.
Sheffield Smelting Co., Ltd., The, Royds Mill Street, Sheffield 4. T: Sheffield 26511. TA: Smelters, Sheffield 4.
Shell-Mex and B.P., Ltd., Shell-Mex House, Strand, London, W.C.2. T: Temple Bar 1234. TA: Shelbeepee, Telex, London.
Short and Mason, Ltd., Aneroid Works, Hale End Road, Walthamstow, London, E.17. T: Larkswood 3371-6. TA: Aneroid, Easphone.
Siebe, Gorman and Co., Ltd., Davis Road, Chessington, Surrey. T: Elmbridge 5900. TA: Siebe, Chessington.
Siemens Edison Swan, Ltd., 155 Charing Cross Road, London, W.C.2. T: Gerrard 8660. TA: Sieswan, Westcent, London.
Silentbloc, Ltd., Manor Royal, Crawley, Sussex. T: Crawley 2100. TA: Silentbloc, Crawley.
Simmonds Aerocessories, Ltd., Byron House, 7-9 St. James's Street, London, S.W.1. T: Whitehall 5772. TA: Aerocessim, London.
Simmons and Hawker, Ltd., Southdown Works, Point Pleasant, Wandsworth, S.W.18. T: Vandyke 4401. TA: Simmonic, Put, London.
Skefco Ball Bearing Co., Ltd., The, Leagrave Road, Luton, Beds. T: Luton 5700. TA: Skefco, Telex, Luton.
Skyhi, Ltd., Skyhi Works, Worton Road, Isleworth, Middx. T: Hounslow 2211/2/3. TA: Skyhijack, Phone, London.
Skylines Aircraft Components, Ltd., 13a London Road, Camberley, Surrey. T: Camberley 1326. TA: Skyaero, Camberley.
Skyways, Ltd., 7 Berkeley Street, London, W.1. T: Grosvenor 7721/5. TA: Skyways, Piccy, London.
Smiths Aircraft Instruments, Ltd., Cricklewood, London, N.W.2. T: Gladstone 3333. TA: Airspeed, London, Telex.
Smith's Stamping Works (Coventry), Ltd., Ribble Road Works, Humber Avenue, Coventry. T: Coventry 3151. TA: Force, Coventry.
Solartron Electronic Group, Ltd., The, Solartron Works, Queen's Road, Thames Ditton, Surrey. T: Emberbrook 5522. TA: Solartron, Thames Ditton.
Southern Forge, Ltd., Meadfield Road, Langley, Bucks. T: Langley (Bucks) 301. TA: Forgings, Slough.
Southern Instruments, Ltd., Frimley Road, Camberley, Surrey. T: Camberley 2230. TA: Minrak, Camberley.
Spa Guilds, Ltd., St. James's Square, Cheltenham, Glos. T: Cheltenham 53312.
Sparklets, Ltd., Queen Street, Tottenham, London, N.17. T: Tottenham 0881. TA: Sparklets, Norphone, London.
Spencer Moulton and Co., Ltd., George, Melksham, Wilts. T: Melksham 3101. TA: Rubber, Melksham.

One of 50 Mercury 10F tractors in use at London Airport. It is seen towing a train of baggage trailers.

(Left) Tecalemit pressure-fed grease and oil units and hose reels behind wall of B.E.A. vehicle-servicing bay.

(Right) "Master" plaster for division into local sections for checking Comet 4 wing tools and formers. James Walker (A.D.), Ltd., makers of form tools.

THE ANCILLARY INDUSTRY . . .

Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middlesex. T: Ealing 6771. TA: Sperigyco, Wesphone, London.

Spring Washers, Ltd., Wobaston Road, Fordhouses, Wolverhampton. T: Fordhouses 2176. TA: Soaring, Wolverhampton.

Standard Insulator Co., Ltd., The Standard Works, Bridge Road, Camberley, Surrey. T: Camberley 1813. TA: Hivoltsit, Camberley.

Standard Telephones and Cables, Ltd., Connaught House, 63 Aldwych, London, W.C.2. T: Holborn 8765. TA: Relay, London.

Steel, Peech and Tozer, The United Steel Companies, Ltd., 17 Westbourne Road, Sheffield 10. T: Sheffield 41011. TA: Phoenix, Sheffield.

Steel Stampings, Ltd., Cookley, Nr. Kidderminster, Worcs. T: Wolverley 266. TA: Stampings, Cookley.

Sterling Metals, Ltd., Gipsy Lane, Nuneaton. T: Nuneaton 4221. TA: Stermet, Nuneaton.

Stewart Aeronautical Supply Co., Ltd., Adastral House, Lowfield Heath, Crawley, Sussex. T: Horley 4300. TA: Sasco, Crawley.

Stone and Co. (Charlton), Ltd., J., Woolwich Road, Charlton, S.E.7. T: Greenwich 3277. TA: Tostones, Wol, London.

Stone and Co. (Deptford), Ltd., J., Arklow Road, London, S.E.14. T: Tideway 1202. TA: Tostones, Telex, London.

Stream-Line Filters, Ltd., Ingate Place, London, S.W.8. T: Macaulay 1011. TA: Edgefilt, Claproad, London.

Suntex Safety Glass Industries, Ltd., Suntex Estate, Thorney Lane, Iver, Bucks. T: Uxbridge 4970. TA: Suntex, Iver.

Super Oil Seals and Gaskets, Ltd., Birmingham Factory Centre, Kings Norton, Birmingham, 30. T: Kings Norton 2041-7. TA: Oilseal, Birmingham.

Surridge's Patents, Ltd., New Works, Croydon Road, Beckenham, Kent. T: Beckenham 0168. TA: Surridge, Beckenham.

Sutton, R. W. (Consultants), Ltd., 7 Lansdowne Place, Cheltenham, Glos. T: Cheltenham 5811 and 53808.

T. E. Tools, Ltd., Gatwick Road, Crawley, Sussex. T: Crawley 2350.

T.I. Aluminium, Ltd., Redfern Road, Tyseley, Birmingham 11. T: Acocks Green 4211. TA: Timinium, Birmingham.

T.K.S. (Aircraft De-Icing), Ltd., Drayton House, Gordon Street, London, W.C.1. T: Euston 4650. TA: Deicing, Phone, London.

Talbot Stead Tube Co., Ltd., Green Lane, Walsall, Staffs. T: Walsall 4186. TA: Talbot, Phone, Walsall.

Tecalemit, Ltd., Marsh Mills, Plymouth, Devon. T: Plymouth 62844. TA: Tecalemit, Plymouth.

Technical Ceramics, Ltd., Woodburcote Way, Towcester, Northants. T: Towcester 312-4.

Technograph Printed Circuits, Ltd., 32 Shaftesbury Avenue, London, W.1. T: Gerrard 4532.

Teddington Aircraft Controls, Ltd., Cefn Coed, Merthyr Tydfil, South Wales. T: Merthyr Tydfil 666. TA: Precision, Merthyr Tydfil.

Teleflex Products, Ltd., Christopher Martin Road, Basildon, Essex. T: Basildon 22861. TA: Teleflex, Phone, Basildon.

Telegraph Construction and Maintenance Co., Ltd., The, Mercury House, Theobalds Road, London, W.C.1. T: Holborn 8711. TA: Telcon, London, Telex.

Telehoist, Ltd., Swindon Lane, Cheltenham, Glos. T: Cheltenham 53254. TA: Telehoist, Cheltenham.

Terry and Sons, Ltd., Herbert, Redditch, Worcestershire. T: Redditch 61. TA: Springs, Redditch.

Test Equipment, Ltd., Gatwick Road, Crawley, Sussex. T: Crawley 2350. TA: Testment, Crawley.

Test Equipment (Models), Ltd., Gatwick Road, Crawley, Sussex. T: Crawley 2350. TA: Testment, Crawley.

Thermal Control Co., Ltd., Marine Works, Sackville Road, Hove, Sussex. T: Hove 34081 and Hove 35929.

Thermionic Products, Ltd., Hythe, Southampton. T: Hythe (Southampton) 3265. TA: Technico, Hythe, Hants.

Thermo-Plastics, Ltd., Luton Road Works, Dunstable, Beds. T: Dunstable 1444. TA: Thermoplastics, Dunstable.

Thompson Bros. (Bilston), Ltd., Bradley Engineering Works, Bilston, Staffs. T: Bilston 41264. TA: Thompbros, Bilston.

Thompson (Engineers), Ltd., Raymond F., Harlow, Essex. T: Harlow 24341/2/3. TA: Rapa, Harlow.

Thorn Electrical Industries, Ltd., 146 Great Cambridge Road, Enfield, Middlesex. T: Enfield 5360. TA: Fergurad, Phone, London.

Thornycroft and Co., Ltd., John I., Smith Square, London, S.W.1. T: Abbey 8000. TA: Thornycroft, Phone London.

Tiltman Langley, Ltd., Redhill Aerodrome, Surrey. T: Nutfield Ridge 2232.

Tipping and Co., Ltd., C. R., Tipco Works, Low Fields Road, Leeds, 12. T: Leeds 30178/9. TA: Tipco, Leeds.

Titanine, Ltd., Sheaveshill Avenue, Colindale, London, N.W.9. T: Colindale 8123. TA: Tetrafree, Hyde, London.

Triplex Safety Glass Co., Ltd., The, 1 Albemarle Street, Piccadilly, London, W.1. T: Hyde Park 8171. TA: Tripsaglas, Piccy, London.

Trist and Co., Ltd., Ronald, Bath Road, Slough, Bucks. T: Slough 25041. TA: Resvalar, Slough.

Tropical Preservation Co., Ltd., Station Approach, Banbury, Oxon. T: Banbury 3123.

Tubes, Ltd., Rocky Lane, Aston, Birmingham, 6. T: Aston Cross 3030. TA: Cylinders, Birmingham.

Tucker Eyelet Co., Ltd., Geo., Walsall Road, Birmingham 22. T: Birchfields 5024. TA: Eyelets, Birmingham.

Tufnol, Ltd., Perry Barr, Birmingham 22B. T: Birchfields 4554. TA: Tufworks, Birmingham 22B.

Tungum Co., Ltd., The, Cheltenham, Glos. T: Cheltenham 5856-7. TA: Tungum, Cheltenham.

Turner Brothers Asbestos Co., Ltd., Rochdale. T: Rochdale 4221. TA: Turners, Rochdale.

Turner Manufacturing Co., Ltd., Wulfruna Works, Villiers Street, Wolverhampton. T: Wolverhampton 24456. TA: Wulfruna, Wolverhampton.

Ultra Electric, Ltd., Western Avenue, Acton, W.3. T: Acorn 3434. TA: Radwaves, Telex, London.

V.P. Sheet Metal, Ltd., 29 Windsor Street, Cheltenham, Glos. T: Cheltenham 5805. TA: Veepee, Cheltenham.

Vactric (Control Equipment), Ltd., 196 Sloane Street, London, S.W.1. T: Sloane 9656. TA: Vactrify, Knights, London.

Valay Industries, Ltd., 186 Campden Hill Road, London, W.8. T: Park 8601. TA: Valaypro, Kens, London.

Vane and Co., A. H., Empire House, St. Martin's-le-Grand, London, E.C.1. T: Metropolitan 9201 and 9202. TA: Avants, Cent, London.

Van Moppes, L. M. and Sons (Diamond Tools), Ltd., Basingstoke, Hampshire. T: Basingstoke 1240. TA: Diatipt, Basingstoke.

Varley Dry Accumulators, Ltd., By-pass Road, Barking, Essex. T: Rippleway 3346.

Venner Accumulators, Ltd., Kingston By-pass, New Malden, Surrey. T: Malden 2442. TA: Venulators, Phone, New Malden.

Venner, Ltd., Kingston By-pass, New Malden, Surrey. T: Malden 2442. TA: Cloxwiches, Phone, New Malden.

Vernons Industries, Ltd., Kirkby Trading Estate, Kirkby, Liverpool. T: Simonswood 3261. TA: Vernex, Liverpool.

Vinten, Ltd., W., 715 North Circular Road, London, N.W.2. T: Gladstone 6373-4-5. TA: Vintacinni-London.

Vokes, Ltd., Henley Park, Guildford, Surrey. T: Guildford 62861. TA: Vokesacess, Guildford.

Vosper, Ltd., P.O. Box 18, Portsmouth. T: Cosham 79481. TA: Repsov, Portsmouth.

Vulcan Products, Ltd., York House, 37 Queen Square, London, W.C.1. T: Chancery 6877. TA: Glossex, Westcent, London.

W.S. Electronics (Production), Ltd., Brunel Road, East Acton, London, W.3. T: Shepherds Bush 7601. TA: Seltric, Ealux, London.

Wakefield and Co., Ltd., C. C., 46 Grosvenor St., London, W.1. T: Mayfair 9232. TA: Cheery, Wesdo, London.

Wakefield-Dick, Industrial Oils, Ltd., 67 Grosvenor Street, London, W.1. T: Grosvenor 6050. TA: Dicotto, Phone, London.

Walker and Co., Ltd., James, Lion Works, Woking, Surrey. T: Woking 2432. TA: Lioncelle, Telex, Woking.

Walker (A.D.), Ltd., James, 15-17 Brunel Road, East Acton, London, W.3. T: Shepherds Bush 2332.

Wallington Weston and Co., Ltd., Vallis Mills, Frome, Somerset. T: Frome 2206-8. TA: Wallington, Frome.

Walter, A. J., Gatwick Airport, Horley, Surrey. T: Horley 1510, Ext. 105-6. TA: Cubeng, London.

Walterisation Co., Ltd., The, Waddon Marsh Way, Purley Way, Croydon, Surrey. T: Croydon 2791. TA: Rustproof, Croydon.

Warden Aviation and Engineering Co., Old Warden Aerodrome, Biggleswade, Beds. T: Northill 288. TA: Oldwarden.

Waymouth Gauges and Instruments, Ltd., Station Road, Godalming, Surrey. T: Godalming 1330-1. TA: Wayco, Godalming.

Wayne Kerr Laboratories, Ltd., The, 3 Roebuck Road, Chessington, Surrey. T: Lower Hook 1131. TA: Waynkerr, Chessington.

Wayne Tank and Pump Co., Ltd., Wayne Works, Newlands Park, London, S.E.26. T: Sydenham 7055-9. TA: Waynal, Forest, London.

Wellwinch Engineering, Ltd., Wellwinch Road, Sittingbourne, Kent. T: Sittingbourne 600-603. TA: Wellwinch, Sittingbourne.

Wellworthy, Ltd., Radial Works, Lymington, Hampshire. T: Lymington 2231-8. TA: Wellworthy, Lymington.

Western Manufacturing (Reading), Ltd., The Aerodrome, Woodley, Reading, Berks. T: Sonning 2351. TA: Hawk, Reading.

Westinghouse Brake and Signal Co., Ltd., 82 York Way, King's Cross, London, N.1. T: Terminus 6432. TA: Westinghouse, London, Telex.

Westminster Airways Servicing, Ltd., Priory Road, Hardway, Gosport, Hampshire. T: Gosport 88081-2-3. TA: Westminair, Gosport.

Westway Models, Ltd., 15/17 Brunel Road, East Acton, London, W.3. T: Shepherds Bush 7022. TA: Miniatures, Ealux, London.

Weyburn Engineering Co., Ltd., Elstead, Surrey. T: Elstead 2141. TA: Weyburn, Elstead.

Whitehouse Industries, Ltd., Ferrybridge, Knottingley, Yorkshire. T: Knottingley 2323.

Whittemore (Aeradio), Ltd., A. J., Croydon Airport, Croydon, Surrey. T: Croydon 8396/7/8. TA: Aeradio, Croydon.

Wiggin and Co., Ltd., Henry, Wiggin St., Birmingham 16. T: Edgbaston 2245. TA: Wiggin, Birmingham.

Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester. T: Gloucester 24021. TA: Compressor, Gloucester.

Williamson Manufacturing Co., Ltd., Litchfield Gardens, Willesden Green, London, N.W.10. T: Willesden 0073/75. TA: Kinetogram, Harles, London.

Wills Pressure Filled Joint Ring, Ltd., Salmon Parade, Bridgwater, Somerset. T: Bridgwater 4171-2. TA: Willseal, Bridgwater.

Wilmot Breeden, Ltd., Amington Road, Birmingham, 25. T: Acocks Green 3344. TA: Bumpers, Birmingham.

Wireless Telephone Co., Ltd.,—see Plessey Group of Companies.

Woodside Die Sinking Co., Ltd., Aire Vale Works, Newlay, Leeds 13. T: Horsforth 4251.

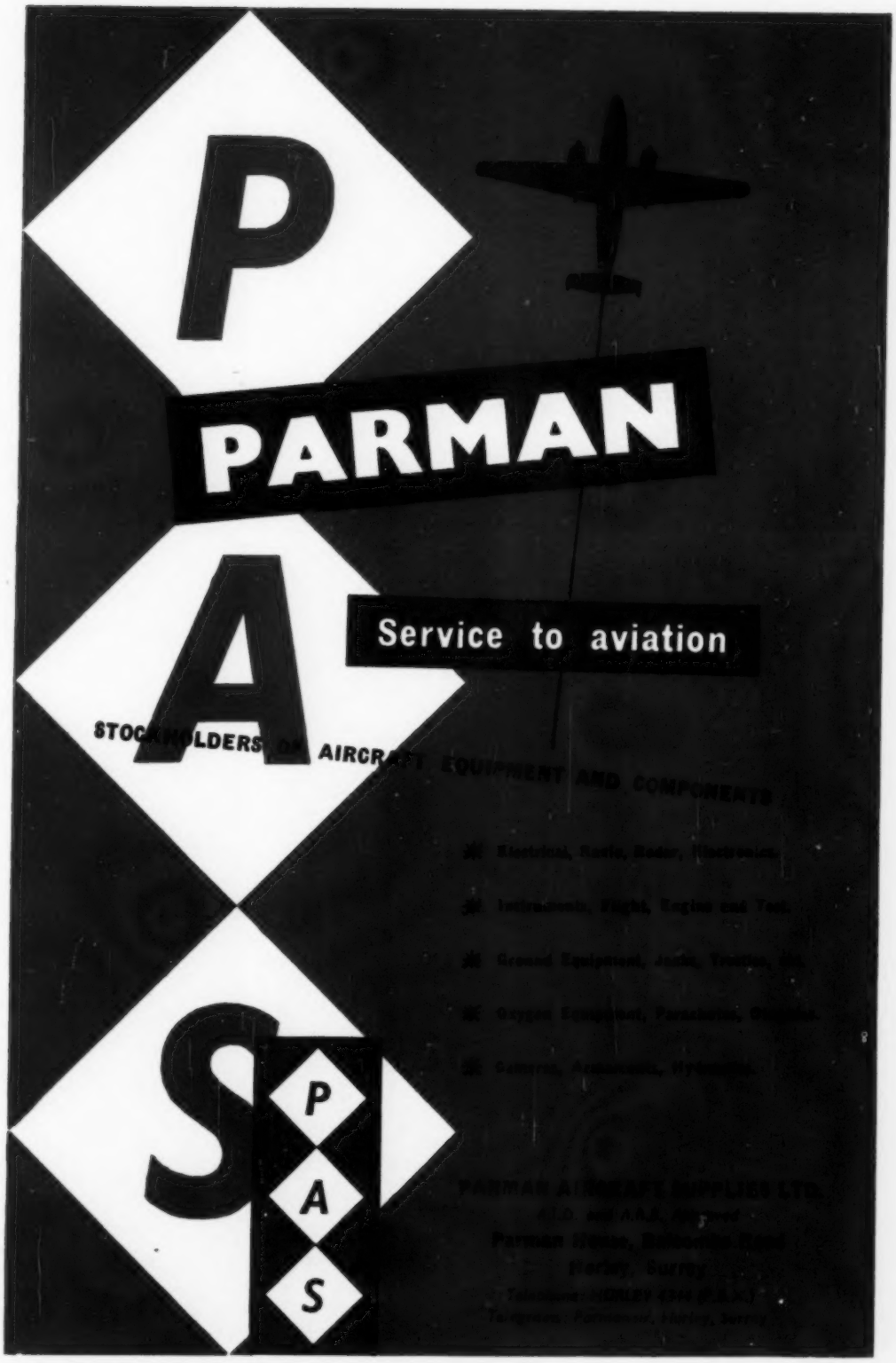
Wynn and Co. (Aircraft), Ltd., E. D., Staverton Aerodrome, Gloucester. T: Churchdown 3264/5. TA: Wynn, Gloucester.

Xetal Products, Ltd., Speke Hall Road, Speke, Liverpool, 19. T: Hunts Cross 2078.

Y.S.C., Ltd., The, 45-47 Copeland Road, London, S.E.15. T: New Cross 6113. TA: Yessee, Peck, London.

Yorkshire Engineering Supplies, Ltd., Upper Wortley Road, Leeds, 12. T: Leeds 6-38234. TA: Yes, Leeds, 12.

Zwicky, Ltd., Buckingham Avenue, Trading Estate, Slough, Bucks. T: Slough 21201. TA: Zwiklim, Slough.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High temperature insulation, especially for jet and turboprop engines, is a speciality of our research and production. Delaney Gallay insulating blankets offer the highest efficiency with the lowest weight penalty and great structural strength. They have proved the successful answer to one of the aircraft designer's more insistent problems.

Likewise, our heat exchangers for aircraft are designed and constructed for the particular purpose required. Strong, light and efficient, they daily prove themselves in thousands of aircraft.

We are experts in heat control. That is why aircraft designers with heat control problems so often look to us for the answer.

A solid bond

Over the years we at Delaney Gallay have spent a good deal of time, energy and money in the business of bonding metals together.

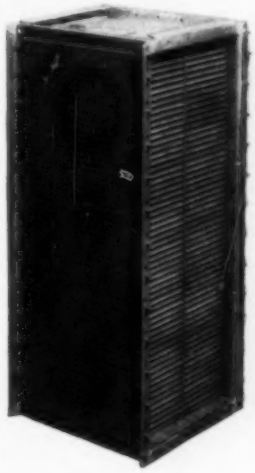
The achievements of aircraft designers have called for the solution to many metallurgical problems and have set up many new ones. This has meant that we, in pursuance of our claim to be knowledgeable about metals, have had to be unremitting in our research.

It has meant, too, the finding, examining, choice and installation of some of the world's most up-to-date equipment for joining metal to metal. Our latest salt bath for brazing aluminium alloys, for example, is the most modern yet devised.

We work by custom in aluminium alloys and stainless steel, but we are always ready to consider problems associated with any metal, including the precious ones if need be. Our research staff, laboratories and test house are constantly employed on somebody's problem. It might be yours. Or it might be that your problem could be phased into our programme of research and production.

We would like to make our activities in this field even more widely known, and to discover those other designers in the aircraft industry to whom our experience in metallurgical matters could be equally valuable.

Visitors to Farnborough who may feel they can hardly afford not to know more about us will find us on Stand No. 155, where they will be most welcome. People unable to get to Farnborough (possibly because they are so busy with problems to which we already have the answer) need only phone or write to us with a note of their requirements.



Heat exchangers in aluminium alloy or stainless steel are but one aspect of the Delaney Gallay range of components where reliable, accurate metal bonding is fundamental.

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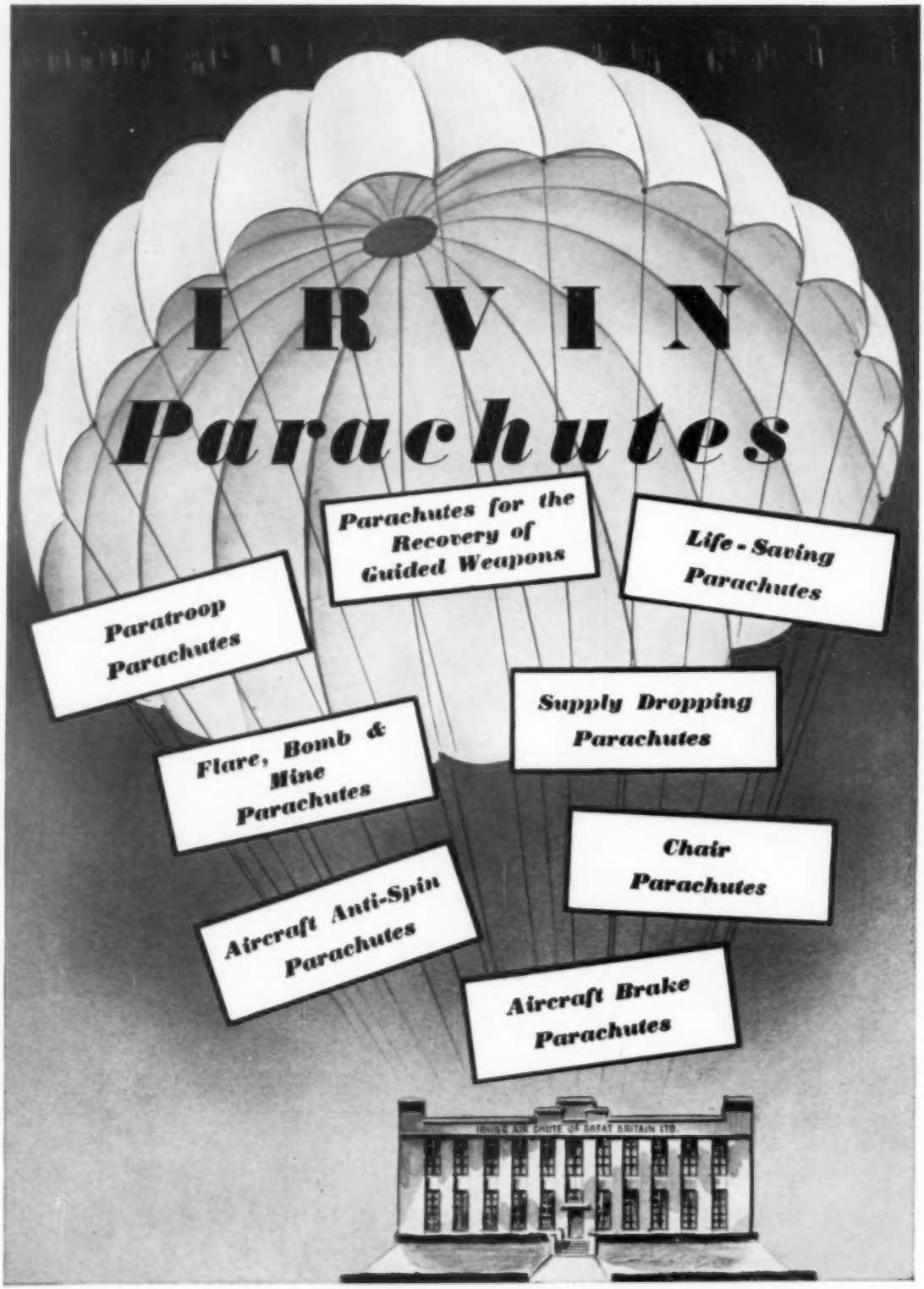

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S.B.A.C. EXHIBITION
FARNBOROUGH

BRITISH MILITARY AIRCRAFT 1957

(INCLUDING RESEARCH AIRCRAFT AND CERTAIN MILITARY TYPES NOW OUT OF PRODUCTION)

Maker and Type	Main Duties	Span ft in	Length ft in	Power Unit(s) No.	Power Unit(s) Type	Power Unit(s) Power (see note 1)	Normal gross wt lb	Wing loading lb sq ft	Armament (see note 2) Guns No. Cal. lb	Armament (see note 2) Bombs No. Wt. lb	Armament (see note 2) R.P.s or Missiles No. Wt. lb	Max. speed m.p.h.	Max. speed ft	Climb to ft	Climb min	Typical Range miles
Armstrong Whitworth:																
Sea Hawk FGA.6	F.Strike	39 0	40 0	1	Nene	5,000+	n.r.	n.r.	4 20	2 500	8 60	600+	n.r.	n.r.	n.r.	n.r.
A.W.660	Tt.	115 0	86 9	4	Dart	8,400	n.r.	n.r.	nil	nil	nil	300+	n.r.	n.r.	n.r.	n.r.
A.W.661	Tt.	115 0	86 9	2	Tyne	10,630	n.r.	n.r.	nil	nil	nil	300+	n.r.	n.r.	n.r.	n.r.
Auster:																
A.O.P.9	O.C.	36 5	23 8½	1	Bombardier 203	180	2,125	10.4	nil	nil	nil	127	—	i.r.c.=	920 ft/min	240
Avro:																
Vulcan B.1	B.	99 0	97 1	4	Olympus	52,000	n.r.	n.r.	nil	A.	nil	600+	n.r.	n.r.	n.r.	n.r.
Vulcan B.2	B.	n.r.	n.r.	4	Olympus BOl.6	64,000	n.r.	n.r.	nil	A.	nil	600+	n.r.	n.r.	n.r.	n.r.
Blackburn and General Aircraft:																
Beverley C.1	Tt.	162 0	99 5	4	Centaurus 173	11,400	135,000	44	nil	nil	nil	242	8,000	7,500	10	1,200
Beverley Development	Tt.	n.r.	n.r.	4	Tyne	21,260?	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
N.A.39	Strike	n.r.	n.r.	2?	n.r.	n.r.	n.r.	n.r.	n.r.	A.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Bristol:																
Britannia 253	Tt.	142 3	124 3	4	Proteus 755	16,480	175,000	84.3	nil	nil	nil	400+	25,000+	—	—	4,480
de Havilland:																
Sea Vixen FAW.20	F.Strike	50 0	53 6	2	Avon	20,000+	n.r.	n.r.	? 30	A.	4 Firestreaks	700+	n.r.	n.r.	n.r.	n.r.
Sea Venom FAW.22	F.Strike	41 9	35 3	1	Ghost	5,000+	n.r.	n.r.	4 20	2 500	8 60	600+	n.r.	n.r.	n.r.	n.r.
Comet C.2	Tt.	115 0	96 0	4	Avon Mk 117	29,320	120,000	59	nil	nil	nil	480+	40,000	—	—	2,300+
Vampire Trainer	T.	38 0	34 6	1	Goblin 35	3,500	11,680	44.7	4 20	opt.	8 25	538	s.l.	30,000	14	789
English Electric:																
P.1A	F.	34 10	49 8	2	Sapphire	n.r.	n.r.	n.r.	2 30	nil	n.r.	1,000+	n.r.	n.r.	n.r.	n.r.
P.1B	F.	n.r.	n.r.	2	Avon	20,000+	n.r.	n.r.	opt.	nil	Firestreaks	1,500	n.r.	n.r.	n.r.	n.r.
Canberra B(I).8	B.I.	64 0	65 6	2	Avon	n.r.	n.r.	n.r.	4 20	A.	opt.	n.r.	n.r.	n.r.	n.r.	n.r.
Canberra P.R.9	R.	68 0	66 8	2	Avon	20,000+	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Fairey:																
Gannet A.S.4 and T.5	A.-S. T.	54 4	43 0	1	Double Mamba	n.r.	n.r.	n.r.	nil	2 1,000	16 60	n.r.	n.r.	n.r.	n.r.	n.r.
Gannet AEW.3	E.W.	n.r.	n.r.	1	Double Mamba	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
F.D.2	R'ch.	26 10	51 7	1	Avon	10,000+	n.r.	n.r.	nil	nil	nil	1,132+	38,000 approx.	n.r.	n.r.	n.r.
Folland:																
Gnat Mk 1	F.B.	22 2	29 9	1	Orpheus	4,850	6,200	45.5	2 30	2 1,000	18 R.P.	M=0.98	—	45,000	5	920
Gnat Trainer	T.	24 0	30 4	1	Orpheus	4,850	7,200	40	nil	opt.	opt.	—	—	40,000	7	920
Gloster:																
Javelin FAW.7	F.	52 0	57 0	2	Sapphire	n.r.	n.r.	n.r.	4 30	nil	4 Firestreaks	700+	n.r.	n.r.	n.r.	n.r.
Javelin T.3	T.	52 0	60 2	2	Sapphire	n.r.	n.r.	n.r.	4 30	nil	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Handley Page:																
Victor B.1	B.	110 0	114 11	4	Sapphire	n.r.	n.r.	n.r.	nil	A.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Victor B.2	B.	n.r.	n.r.	4	Conway RCo.11	69,000	n.r.	n.r.	nil	A.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Hawker:																
Hunter F.6	F.B.	33 8	45 3	1	Avon	10,000+	n.r.	n.r.	4 30	2 1,000	24 60 or 2 Firestreaks	700+	n.r.	n.r.	n.r.	n.r.
Hunter Two-Seater	T.	33 8	48 10	1	Avon	10,000+	n.r.	n.r.	2 30	n.r.	n.r.	700+	n.r.	n.r.	n.r.	n.r.
P.1121	Strike	n.r.	n.r.	1	Gyron	20,000+	n.r.	n.r.	n.r.	A.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hunting Percival:																
Jet Provost T.3	T.	35 2	31 11	1	Viper ASV.8	1,750	7,050	33	nil	nil	nil	330	30,000	20,000	11.4	310
Pembroke	Tt.T.	64 6	46 0	2	Leonides	1,100	13,500	33.7	nil	nil	nil	220	2,000	10,000	10.5	1,030
Miles:																
Student 1	T.	29 2	30 9	1	Marboré 2	880	3,500	26	nil	nil	nil	293	20,000	10,000	6.8	327
Student 2	T.	29 2	30 9	2	Palas	700	3,500	26	nil	nil	nil	281	s.l.	20,000	16.8	400
Centurion 3	T.	29 2	31 6	1	RB. 108	n.r.	4,000	27.8	opt.	opt.	opt.	351	20,000	10,000	4.1	488
Centurion 4	T.	29 2	31 6	1	Gourdon	1,410	4,000	27.8	opt.	opt.	opt.	415	30,000	10,000	3.6	373
Centurion 5	T.	29 2	31 6	2	Arbizon	1,100	4,000	27.8	opt.	opt.	opt.	353	25,000	10,000	5	452
Saunders-Roe:																
S.R.53	F.	25 1	45 0	2	Spectre+ Viper	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Short:																
S.C.1	R'ch.	n.r.	n.r.	5	R.B.108	n.r.	n.r.	n.r.	nil	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Vickers-Armstrongs:																
Valiant B.1 (and variants)	B.R.	114 4	108 3	4	Avon	40,000+	120,000+	n.r.	nil	A.	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Vickers-Supermarine:																
Scimitar F.1	F.Strike	37 2	56 2	2	Avon	20,000+	n.r.	n.r.	4 30	A.	?	700+	n.r.	n.r.	n.r.	n.r.
Swift F.R.5	F.R.	32 4	42 3	1	Avon	n.r.	n.r.	n.r.	2 30	nil	nil	n.r.	n.r.	n.r.	n.r.	n.r.
Swift F.7	F.	—	—	1	Avon	n.r.	n.r.	n.r.	nil	nil	4 Fireflashes	n.r.	n.r.	n.r.	n.r.	n.r.

Abbreviations: A. = atomic capability; A.-S. = anti-submarine; B. = bomber; C. = communications; E.W. = early warning; F. = fighter; I. = intruder; i.r.c. = initial rate of climb (ft/min); n.r. = not released; O. = observation; R. = reconnaissance; R'ch. = research; r.o.c. = rate of climb; R.P. = rocket projectile; s.l. = sea level; T. = training; Tt. = transport. **Notes:** (1) For piston engines and turboprops power (in h.p.) is for take-off; for turbojets, thrust (in lb) is static. (2) Bomb and R.P. loads are generally alternatives.

BRITISH CIVIL AIRCRAFT 1957

(INCLUDING TYPES NOT YET IN PRODUCTION)

Maker and Type	Span	Length	Wing Area	Powerplant			Gross Weight	Max. Pay-load	Max. Seats	Max. Fuel	Typical Performance				Typical Field Length (note 3)
				No.	Type	Power (note 1)					Stage Length (note 2)	Height	Speed	Pay-load	
	ft in	ft in	sq ft				lb	lb		Imp gal	st. miles	ft	st. m.p.h.	lb	ft
Armstrong-Whitworth:															
A.W.650 Freightercoach (note 4)	115 0	86 9	1,450	4	Dart 526 (note 5)	8,400	82,000	28,000	77	3,300	1,830	20,000	276	25,000	4,050
Auster:															
Alpine	36 0	23 2	185	1	Gipsy Major 10	145	1,827	—	3	16	230	4,000	101	460	630
Atlantic	36 0	23 10	185	1	Continental E.185-10	205	2,700	—	4	32	450	7,000	128	570	525
Agricola	42 0	28 0½	254.7	1	Continental O-470-M2	240	3,675	4,400	1	24	218	1,000	101	1,400	555
Aviation Traders															
Accountant	82 6	62 1	632	2	Dart 512	3,480	28,500	10,000	28	1,280	1,020	25,000	295	5,600	3,220
Blackburn															
Universal	162 0	99 2	2,916	4	Centaurus 873	12,880	143,000	50,000	160	6,880	500	8,000	180	48,000	3,780
Bristol															
Britannia 310	142 3½	124 3	2,075	4	Proteus 755	16,480	175,000	28,000	133	8,486	3,800	30,000	350	28,000	6,360
de Havilland															
Comet 4	115 0	111 6	2,121	4	Avon RA.29	42,000	152,500	19,300	76	8,950	2,700	42,000	506	19,300	6,480
Comet 4B	107 10	118 0	2,066	4	Avon RA.29	42,000	152,500	22,280	99	7,840	2,000	23,500	530	20,000	6,480
Dove 5	57 0	39 3	335	2	Gipsy Queen 70 Mk 2	760	8,800	1,800	11	133	490	8,000	179	1,672	2,430
Heron 2	71 6	48 6	499	4	Gipsy Queen 30 Mk 2	1,000	13,150	3,050	17	316	400	8,000	183	3,050	2,595
Edgar Percival															
E.P.9	43 6	29 6	228	1	Lycoming GO-480B	270	3,550	1,540	2	56	540	S.L.	120	1,540	315
Handley Page															
Herald	94 9½	70 3	886	4	Leonides Major 701	3,480	37,500	10,100	44	700	600	10,000	180	8,000	2,930
Dart-Herald	94 9½	71 11	886	2	Dart 527	3,980	37,000	10,160	44	1,000	800	15,000	275	9,200	4,170
Civil Victor	126 0	126 3	—	4	Conway	—	214,000	40,000	172	—	910	40,000	600	40,000	6,120
Hunting Percival															
President	64 6	46 0	400	2	Leonides 503	1,080	13,500	3,960	12	238	920	8,000	150	2,600	3,795
Miles															
H.D.M. 106	75 4	37 10	279	2	Lycoming GO-480 (note 6)	580	8,000	3,040	15	150	250	5,000	120	3,000	1,005
Scottish Aviation															
Pioneer 2	49 9	34 6	410	1	Leonides 502	520	5,800	1,500	4	56	350	5,000	121	1,300	690
Twin Pioneer	76 6	45 3	657	2	Leonides 502	1,080	13,500	3,500	16	180	300	5,000	117	2,700	894
Vickers-Armstrongs															
Viscount 700D	93 8½	81 10	963	4	Dart 510	6,960	63,000	10,840	53	1,967	1,265	20,000	325	10,840	4,650
Viscount 810	93 11	85 8	963	4	Dart 525	7,960	67,500	12,510	63	1,900	960	20,000	360	12,510	6,000
Viscount 840	93 11	85 8	963	4	Dart 541	9,400	69,000	12,420	63	1,900	1,100	20,000	400	12,420	—
Vanguard	118 0	122 10	1,529	4	Tyne 2	18,400	141,000	25,000	130	5,100	2,120	20,000	425	25,000	6,400
VC-10	—	—	—	4	Conway	—	—	—	147	—	—	—	—	—	—

Notes: (1) Powers are in b.h.p. (pistons), e.h.p. (turboprops), lb static thrust (jets). (2) Range with full fuel reserves. (3) With engine-cut at critical speed in case of multi-engine types. (4) The A.W.670 is the unpressurized car-ferry version. (5) Two R-R. Tynes as an alternative. (6) Supercharged version if required.

BRITISH HELICOPTERS 1957

Maker and Type	Main Rotors	Rotor Diam.	Fuse-lage Length	Power Unit(s)			Gross Weight	Disc Loading	Disposable Load	No. of Pass.	Typical Performance			
				No.	Type	Power					Range	Height	Speed	Pay-load
		ft in	ft in			h.p.	lb	lb/sq ft	lb		miles	ft	m.p.h.	lb
Bristol:														
Type 171 (Sycamore)	1	48 7	42 0	1	Leonides 73	515	5,400	2.87	1,340	3/4	270	s.l.	91	706
Type 173 Mk 3	2	48 7	54 2	2	Leonides Major	1,700	13,500	3.63	3,561	10	n.r.	n.r.	n.r.	n.r.
Type 192	2	48 8	54 4	2	Gazelle	2,600	18,000	4.83	—	23 troops	149	—	138	3,250
Fairey:														
Rotodyne	1	90 0	58 8	2	Eland	7,000	39,000	6.14	14,970	40/48	345		170	9,000
Ultra-light	1	28 3	14 8	1	Palouste	258	1,800	2.87	843	1	Max. range 185 miles			
Saunders-Roe:														
Skeeter Mk 12	1	32 0	28 5	1	Gipsy Major 215	215	2,200	2.86	544	1	Max. range 213 miles			
Westland:														
Wessex	1	56 0	49 11	1	Gazelle NGa.13	1,400	12,600	5.1	5,000	12	Max. range 391 miles			
Whirlwind 5	1	53 0	42 0	1	Leonides Major	750	7,800	3.5	2,530	10 troops	Max. range 333 miles			
Whirlwind 7	1	53 0	42 0	1	Leonides Major	750	—	—	—	—	Max. range 483 miles			
Widgeon	1	49 2	41 3	1	Leonides 521/1	515	5,900	3.11	1,578	4	Max. range 300 miles			
Westminster	1	72 0	65 0	2	Eland	—	33,000	8.09	13,000	43 troops	Max. range 500 miles			

TECHNIQUE

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The October issue includes two main items:—

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2. 'The Analysis of Muscle Potentials by means of a Muirhead Pametrada Wave Analyser', by A. Nightingale, M.A., F.Inst.P., Physics Department, Guy's Hospital Medical School, London.

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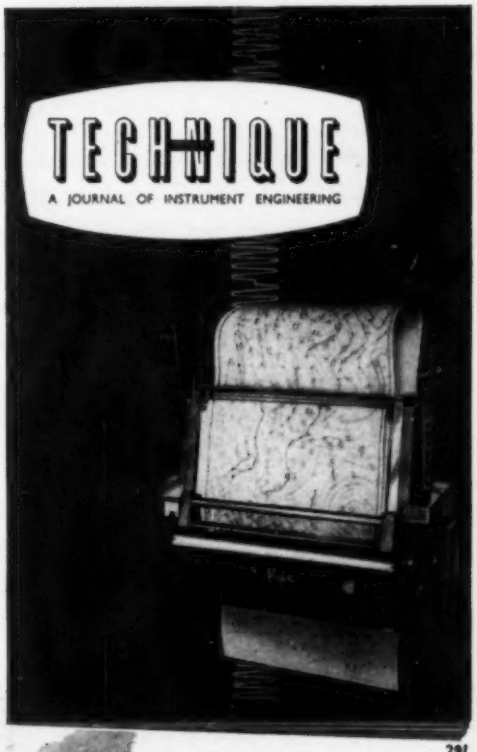

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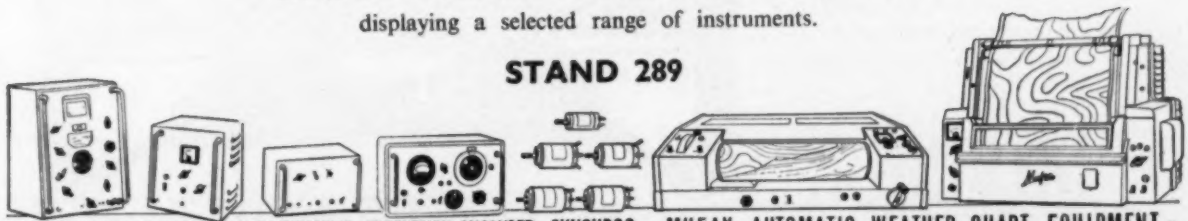

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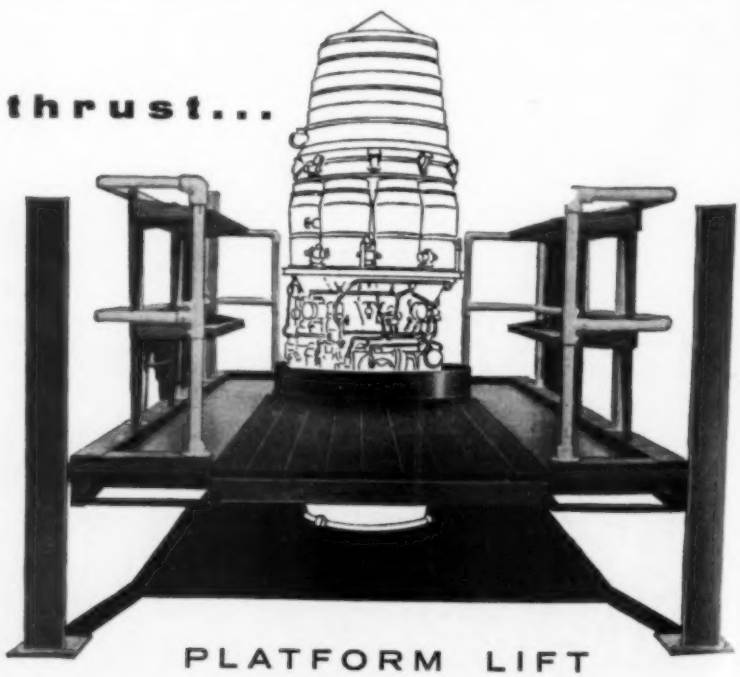

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BRITISH AERO ENGINES 1957

Maker and Type	Classification	Swpt. vol. (cu. in.) or mass flow (lb/sec)	Max boost (lb/sq in) or press. ratio	Max. rated power				Typical cruising s.f.c.	Power/weight ratio (per lb)	Remarks
				s.h.p.	lb thrust	r.p.m.	s.f.c.			
Alvis:										
Leonides 503/8 ...	P, 9r, air	719	8 lb	570	n.a.	3,000	—	0.50	0.73	Fixed-wing engine.
Leonides 524/1 ...	P, 9r, air	719	7 lb	565	n.a.	3,200	—	0.49	0.89	Helicopter engine.
Leonides Major 151	P, 14r2, air	1,118	9 lb	860 (1hr)	n.a.	2,900	0.72	0.48	0.86	Helicopter engine.
Leonides Major 701	P, 14r2, air	1,118	9¼ lb	875	n.a.	3,000	0.72	0.48	0.76	Herald powerplant.
Armstrong Siddeley:										
P.181/182 ...	T, 2c, ann, 2t+1t	12.5	n.r.	1,000	200	n.r.	0.687	n.r.	2.58	Preliminary specification.
Double Mamba ASMD.8 ...	T, 2 (1*a*, *ann*, 3t)	n.r.	n.r.	3,600	600	n.r.	n.r.	n.r.	n.r.	Gannet powerplant.
Sapphire 200 (Sa.7)	J, 13a, ann, 2t	n.r.	n.r.	n.a.	11,000	8,600	0.885	n.r.	3.6	12,300 lb with simple reheat.
Viper 101 (ASV.8)	J, 7a, ann, 1t	32	3.75	n.a.	1,750	13,800	1.12	—	3.34	Trainer engine.
Viper ASV.10 ...	J, 7a, ann, 1t	42	4.1	n.a.	2,000	13,400	1.01	—	3.52	Future standard engine.
Blackburn:										
Bombardier 702 ...	P, 4l, inv., air	389	n.a.	173-220	n.a.	2,600	—	0.45	0.5-0.6	Auster A.O.P.9.
Artouste 610 ...	T, 1c, ann, 2t	7.2	4.12	475	—	34,000	0.99	—	1.72	Single-shaft turbine.
Palouste 500 ...	GP, 1c, ann, 1t	4.7	4.19	2.725 lb air per sec at 56.25 lb/sq in at 35,000 r.p.m. (258 gas h.p.) for fuel consumption of 310 lb/hr.					1.455	Fairey Ultra-Light.
Bristol:										
Centaurus 173 ...	P, 18r2, air	3,270	14 lb	2,940	n.a.	2,800	—	0.42	0.89	Beverley.
Proteus 755 ...	T, 12a+1c, 8cc, 2t+2t	43.5	7.2	3,670	1,220	12,000	0.6	0.45	1.51	Britannia.
Orion BOn. 2 ...	T, 7a+5a, cann, t+3t	82	Over 10	4,400	1,950	10,000*	0.64	0.40	1.89	Constant power to 20,000 ft.
Olympus 104 ...	J, 7a+8a, *cann*, t+t	n.r.	n.r.	n.a.	13,000	n.r.	n.r.	n.r.	n.r.	Vulcan B.1.
Olympus 200 (BOl.6)	J, 5a+7a, *cann*, t+t	n.r.	n.r.	n.a.	16,000	n.r.	n.r.	n.r.	n.r.	Vulcan B.2.
Orpheus BOr. 3 ...	J, 7a, *cann*, 1t	n.r.	n.r.	n.a.	4,850	n.r.	n.r.	n.r.	6.0	In production.
Zephyr	J, 5a+7a, cann, t+t	n.r.	10.5	n.a.	12,500	n.r	0.718	0.88	3.5	Commercial transport engine.
Thor BT.1	RJ, radial spray bars	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	In production for Bloodhound.
de Havilland:										
Gipsy Queen 70/2	P, 6l, inv, air	622	7.5 lb	380	n.a.	3,000	—	0.46	0.526	Dove powerplant.
Gipsy Major 215 ...	P, 4l, inv, air	416	—	215	n.a.	—	—	0.53	2.0	Can have turbo-supercharger.
Goblin 35	J, 1c, 16cc, 1t	63	3.67	n.a.	3,500	10,750	1.14	—	2.15	Vampire Trainer.
Ghost 53 Mk 1 ...	J, 1c, 10cc, 1t	88.5	4.7	n.a.	5,300	10,350	1.19	—	2.5	Sea Venom; cooled n.g.vs.
Gyron DGy.2 ...	J, 7a, ann, 2t	n.r.	n.r.	n.a.	20,000	n.r.	1.04	n.r.	4.7	25,000 lb with reheat.
Gyron Junior DGJ.1	J, a, ann, t	n.r.	n.r.	n.a.	7,000	n.r.	n.r.	n.r.	n.r.	Also later versions.
Spectre	R, HTP+Avtur	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Several versions.
Super Sprite ...	R, HTP+Avtur	n.r.	n.r.	n.a.	4,000	n.a.	n.r.	—	2.75	Jettisonable a.t.o. pack.
Napier:										
Eland 151	T/GP, 10a, 6cc, 3t +aux. comp. 9a	31	7	2,805	520	12,500	0.624	0.493	1.91	For Rotodyne.
Eland NEI.6 ...	T, 10a, 6cc, 3t	31	7	3,150	960	12,500	0.595	0.525	2.1	Fixed-wing turboprop.
Gazelle NGa.13 ...	T, 11a, cann, 2t+t	n.r.	n.r.	1,800 (5 min.)	—	20,400	0.664	—	2.2	Wessex.
Gazelle NGa.2 ...	T, 11a, cann, 2t+t	n.r.	n.r.	1,650 (1 hr)	—	20,400	0.67	—	2.0	Bristol 192.
RJTV.27	RJ, diametral centre-body	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Developed for N.G.T.E.
Scorpion	R, HTP+Avtur	n.r.	n.r.	n.a.	n.r.	n.a.	n.r.	n.r.	n.r.	Usually twin barrels.
Rolls-Royce:										
Avon RA.21 ...	J, 12a, 8cc, 2t	n.r.	n.r.	n.a.	8,000	7,900	0.925	—	3.17	Out of production.
Avon RA.24 ...	J, a, cann, t	n.r.	n.r.	n.a.	11,250	n.r.	n.r.	n.r.	n.r.	Military; can have reheat.
Avon RA.28 ...	J, 15a, cann, 2t	n.r.	n.r.	n.a.	10,000	8,000	0.86	n.r.	3.58	Military.
Avon 524 (RA.29) ...	J, 16a, cann, 3t	n.r.	n.r.	n.a.	10,500	8,000	0.775	n.r.	3.16	Commercial transport engine.
Nene RN.6 ...	J, 1c, 9cc, 1t	90	4	n.a.	5,400	12,500	1.06	—	3.2	Sea Hawk engine.
RB.108	J, a, ann, t	n.r.	n.r.	n.a.	n.r.	n.r.	n.r.	n.r.	n.r.	Used in Short S.C.1.
Dart 510	T, 2c, 7cc, 2t	20	5.5	1,600	370	14,500	0.689	0.635	1.57	1,500-hr overhaul life.
Dart 526 (RDa.7/2)	T, 2c, 7cc, 3t	22	5.75	1,910	505	15,000	0.665	0.57	1.88	Three-stage turbine.
Dart 545 (RDa.11)	T, 2c, 7cc, 3t	n.r.	n.r.	2,970	508	15,000	0.635	0.56	2.5	Cooled blades.
Tyne I	T, a+a, cann, t+3t	46	13	4,220	n.r.	15,250*	—	about 0.4	2.4	Vanguard two-spool engine.
Tyne III	T, a+a, cann, t+3t	—	—	5,235	n.r.	—	—	under 0.4	2.85	In service 1963.
Conway RCo.10 ...	BP, a+a, cann, t+t	n.r.	n.r.	n.a.	16,500	n.r.	n.r.	n.r.	n.r.	Commercial transport engine.
Conway RCo.11 ...	BP, a+a, cann, t+t	n.r.	n.r.	n.a.	17,250	n.r.	n.r.	n.r.	n.r.	For Victor B.2.

Notes: entries in italics are unofficial but have been published elsewhere or can be deduced from publishable evidence; in col 2, P = piston engine, T = turboprop, J = turbojet, BP = by-pass turbojet, GP = gas producer for rotor tip-jets, R = rocket, c = centrifugal compressor, a = axial compressor, cc = combustion chambers, t = turbine stages, ann or cann = annular or cannular combustion chamber, r = radial, l = in-line, inv. = inverted, Avtur = aviation turbine fuel, H.T.P. = high-test hydrogen peroxide. All determinations of s.f.c. (specific fuel consumption), and power/wt ratio are based upon static sea-level lb thrust, b.h.p. or total equivalent s.h.p., according to the type of engine considered. *Indicates r.p.m. of low-pressure section. Throughout: n.a. = not applicable; n.r. = not released for publication.

BRITISH GUIDED MISSILES 1957

Name	Mission	Prime contractor	Chief associate(s)	Propulsion	Boost system	Firing weight (lb)	Length	Guidance	Remarks
Fireflash ...	Air-air	Fairey	Plessey, Ekco	Two jettisonable solid motors	None	250 lb?	9ft 7in	Beam rider	In production, in service
Firestreak ...	Air-air	D.H. Propellers	Mullard	Solid motor	None	300 lb?	Over 10ft	Infra-red	In production for R.A.F., R.N.
Red Dean ...	Air-air	Vickers-Armstrongs	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	For all-weather interception
Bloodhound	Surf.-air	Bristol Aircraft	Ferranti	Two ramjets	Four w.r.m.	About 2,000 lb	22ft 2in	Semi-active	In production for R.A.F.
Thunderbird	Surf.-air	English Electric	Marconi, Napier	Solid motor	Four w.r.m.	About 2,000 lb	About 20ft	Semi-active	In production for Army, R.A.F.
Sea Slug ...	Ship-air	Armstrong Whitworth	G.E.C., Sperry	Liquid or solid motor	Four w.r.m.	n.r.	n.r.	n.r.	For Royal Navy
—	Air-surf.	Avro	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	"Stand-off bomb" for V-bombers
—	Surf.-surf.	English Electric? D.H. Propellers?	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	2,000-mile range

Notes: In col. 5 "solid motor" = a solid-propellant rocket motor; in col. 6 w.r.m. = "wrap-round" boost motors; in all cases n.r. = not released for publication.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Miniature Controls

MAY I say how interested I was to read (*Flight*, August 9, page 181) of Boulton Paul's success in operating an electrically signalled powered control in the Tay Viscount? I do not think the significance of this event can be overstated. Such a strong case can be advanced for throwing away the mechanical link between the stick and surface that it is surely only the need for proving an electrical system can be just as reliable, and quieting the qualms of mistrustful pilots, that prevents its more ready acceptance—at least as a concept if not as a next-generation control fact.

I would, however, like to challenge your remark that "further development will obviously lead to a system where the pilot has only a very small control column . . . which would offer finger-light operation." I do not think the advent of such systems is obvious at all; the few academic attempts to fly "no-force" control systems have required such intense concentration that the onset of fatigue has been accelerated, to put it mildly. Some sort of feel system (which implies graded force per "g" or movement per "g" or a combination of both) will always be required, and the best-liked systems still appear to be those which approximate to a constant stick force per "g." This means that the control column must be large enough to allow the forces and movements to be applied. Besides, with a miniature control column, what would happen to the multiplicity of buttons and slides that have so conveniently come to decorate the grip?

London, S.W.1. STICKSHAKER.

Pat Johnson's Reminiscences

I WISH to say how much I appreciate the articles "Leaves from a Log-book" by Patrick Johnson and hope that one day he will write a full-size book from his log. Of interest is his belief that the Blackburn Lincock G-AALT, sometime after 1931, was the first aeroplane to do a complete "outside loop," which he performed near Mousehold Heath aerodrome. According to Quentin Reynolds' book *The Amazing Mr. Doolittle*, Jimmy Doolittle performed this on May 25, 1927, flying a 450 h.p. Curtiss P.1 fighter.

Birmingham 14. MAURICE AUSTIN.

Modern G.C.A.

HAVING just returned from five weeks in Europe and the U.K., I have enjoyed reading two letters in your Correspondence section concerning G.C.A. Incidentally, we find your publication informative, accurate and beneficial.

The initial communication from Mr. J. M. Wilde, in your issue of May 31, commented on our AN/CPN-4 G.C.A. equipment and the subsequent letter from Frank Taylor, appearing in your issue of June 28, properly emphasizes the equipment which he has designed at S.T.C.

To put the record straight, it may be of interest to your readers to know that the R.A.F. have 34 of the Gilfillan AN/CPN-4 G.C.A. equipments in operation at R.A.F. stations for the past four years and the Royal Navy also use the AN/CPN-4 G.C.A. equipment at their stations throughout the United Kingdom. This AN/CPN-4 G.C.A. equipment, the latest version nomenclatured AN/MPN-11, is the standard G.C.A. equipment of the U.S.A.F., the U.S. Navy, the U.S. Marine Corps, and the U.S. Army, as well as the air forces and the navy establishments of 34 countries around the world, including Canada, South Africa, Australia, etc.

The CPN-4/MPN-11 equipment is a self-contained navigation system with three complete operating positions permitting the control of three aircraft simultaneously by three G.C.A. operators. Each position provides a 12in search scope and a 12in final-approach displaying azimuth, elevation, and range information on the single three-dimensional display. The search beam shows all aircraft to an altitude of 20,000ft and at a range of 40 miles with the standard antenna tilt. The two mobile trailers provide complete communications equipment, air conditioning, heaters, power generators, spare components, test equipment and shelter. This complex radar system contains 1,500 tubes and 13 miles of circuitry. Gilfillan is proud to have developed, produced and delivered over 500 of these G.C.A. equipments which have found such wide acceptance throughout the military and civil aviation organizations of the free world.

Our latest contribution is automatic G.C.A. which is an accessory to the basic CPN-4 equipment and is capable of controlling six aircraft on final approach simultaneously.

We are currently producing Quadradar, which is a lightweight, tactical G.C.A. equipment weighing 3,800 lb with a final approach range of 40 miles and altitude coverage of 50,000ft. This is the first G.C.A. equipment capable of giving jet aircraft a straight-in jet penetration approach from extreme altitude and range to touchdown. This equipment is currently in operation by our four U.S. military services and by the governments of Canada, Ireland, Argentina, Austria, France, Finland and Italy. An even lighter weight version of Quadradar is currently under development for the U.S. Marine Corps.

We deeply regretted the Vulcan crash on G.C.A. at London Airport. I refrained from commenting on your excellent coverage of this unfortunate incident, as it seemed to be inappropriate at the time. It did seem obvious that the G.C.A. operators in London should not have been asked to control a high-performance modern jet aircraft with obsolete radar equipment designed in 1942 for slower-moving propeller aircraft—particularly when newer G.C.A. equipment is available at R.A.F. and R.N. stations in the area.

Los Angeles, Calif. LEONARD DAVID CALLAHAN, Vice President, Gilfillan Bros., Inc.

Turboprop v Turbojet

QUITE a number of your correspondents seem to agree that their representative turbojet will cost 50 per cent more than the equivalent turboprop. When one machine is more expensive than another, it pays to use the former more intensively, and it seems improbable that the assumption of the same utilization for each aeroplane is correct.

By increasing the utilization of an aeroplane costing £1.33m from 2,500 to 3,000 hours one would reduce the fixed cost per flying hour from £132 to £110, using Lord Douglas' figures. If this was achieved wholly by spending more on direct engineering labour and supervision, the saving would be sufficient to pay about twice as much in overtime and night-shift premiums, and through working for short periods with large numbers of men. The operator would still be left with the extra profit earned, which might run at the rate of £40 per hour flown, or more.

Similar results can be achieved by spending more on crew expenses, and larger ground crews. One chooses the regime which extracts the maximum profit from the aeroplane; not the one which seems to minimize any particular item of cost.

Crediting the turbojet with a higher utilization clearly narrows the cost advantage of the turboprop. The considerations outlined above might lead one to operate both types at a higher level of utilization than some of your correspondents have assumed, which again benefits the turbojet.

London, W.C.2. A. J. LUCKING.

Status of the Technician

WHEN so many technicians are leaving this country for the North American continent it is, perhaps, pertinent to ask whether the British aircraft engineer enjoys working conditions in keeping with his professional status.

We would say most emphatically "No." Compared with the other professions, the status of the engineer is little better than that of a junior civil servant.

No professional man should be a slave to the time clock, yet in our particular aircraft firm, design staff must stamp a clock card three times a day. Furthermore, one must provide one's own cutlery for use in the canteen, and one's own crockery for the tea break.

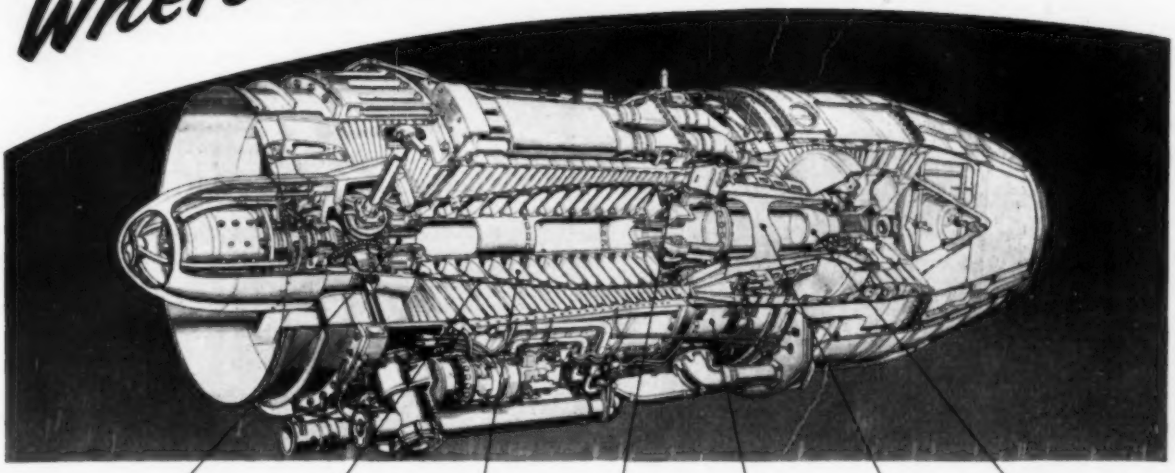
These are conditions which would be unacceptable in any other profession and they must certainly be considered by those who look to other shores for their employment.

TWELVE AIRCRAFT TECHNICIANS
(Names and addresses supplied).

FORTHCOMING EVENTS

Aug. 31. R.N.A.S. Lee-on-Solent, Hampshire: At Home.
Sept. 1-15. Anglo-American Conference, London and Folkestone.
Sept. 2-8. S.B.A.C. Show, Farnborough. (Public Days, 6th, 7th, 8th).
Sept. 5. Helicopter Association of Great Britain: Annual Dinner, Dorchester Hotel.
Sept. 9-15. Battle of Britain Week.
Sept. 13. Royal Aeronautical Society: 45th Wilbur Wright Lecture: "Advanced Education and Academic Research in Aeronautics," by Dr. Clark B. Millikan, Hon. F.I.A.S., F.R.Ae.S.
Sept. 14-15. Popular Flying Association: Rally, Sywell.
Sept. 15. R.Ae.S. Garden Party, Wisley.
Sept. 16-20. Institute of Metals: 49th Annual Autumn Meeting.
Sept. 19-22. Austrian Aero Club: Innsbruck and Salzburg International Air Rally, Innsbruck.
Sept. 21. R.N.A.S. Abbotsinch, Paisley: At Home.

Where anti-corrosion counts



Vital internal components of the Armstrong Siddeley "SAPPHIRE" turbo jet engine, power unit of the famous "English Electric" P.1A prototype aircraft, are protected against corrosion by the

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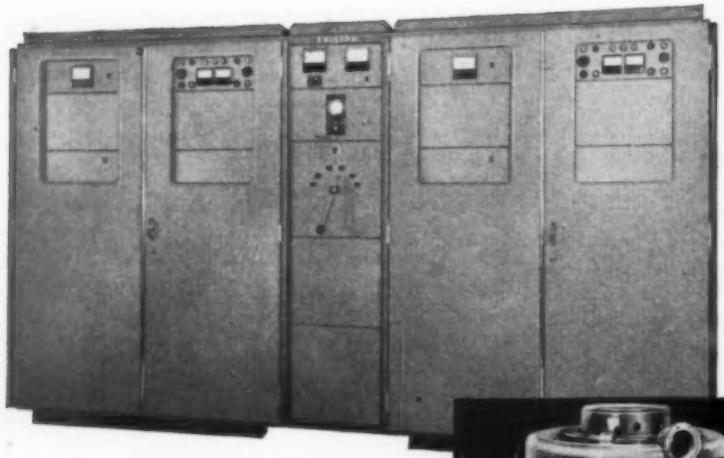

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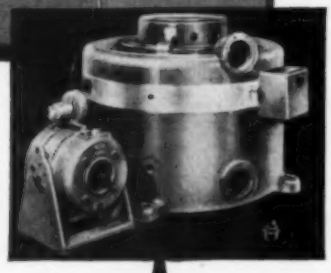

PHILIPS amplifiers for industry

In addition to providing public address amplifiers of all sizes, Philips supply high power amplifiers for use as stable frequency sources and for driving vibrators. The illustration shows the Philips 20 KVA Amplifier, specially designed in co-operation with Messrs. Goodmans Industries Ltd. for driving the Goodmans Vibration Generator, Model VG 109, used in engineering research and development. Full details of this equipment are available from the address below.

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A Bristol Freighter of No. 41 Sqn., R.N.Z.A.F., leaves New Zealand for Malaya where the squadron carries out medium-transport and supply-dropping duties and is based at Changi on Singapore Island.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

No. 99 Sqn. Standard

ON September 27, at R.A.F. Lyneham, a Standard is to be presented to No. 99 Squadron by Air Chief Marshal Sir Ronald Ivelaw-Chapman, V.C.A.S., who flew with the squadron in 1926-28.

Forty years old this month, No. 99 Squadron—now equipped with Hastings aircraft and commanded by S/L. T. M. Stafford—has had a varied existence since it was formed at Yatesbury in 1917 with D.H.9s and took part in operations on the Western Front from May 1918 onwards as part of Trenchard's Independent Force.

After the war, No. 99 had a short spell on air-mail duties in Europe and frontier patrols in India, then in 1924 resumed its original rôle as a bomber squadron. It was equipped successively with Aldershots, Hyderabads, Hinaidis and Heyfords and at the start of the last war was flying Wellingtons from Mildenhall in Suffolk—with them taking part in costly daylight operations, switching to night bombing in 1940.

In February 1942, No. 99 moved to India, becoming the first R.A.F. long-range bomber squadron to operate against the Japanese in Burma; in November 1944 it was re-equipped with Liberators, and later these were based on the Cocos Islands.

No. 99 Sqn. was disbanded in 1945 but reformed two years later in Transport Command, its Yorks taking part in Operation "Plainfare" for the relief of Berlin. When an anonymous donor presented a gold cup to commemorate the achievements of Transport Command in that operation, this was won in the first annual competition for it (in 1955) by No. 99 Sqn.

Senior Appointments

TWO senior appointments announced recently by Air Ministry are those of A.V-M. W. H. Kyle, who is to be A.C.A.S. (Operational Requirements) with effect from September 1, and of A.V-M. H. J. Kirkpatrick as S.A.S.O. at 2nd T.A.F.

A.V-M. Kyle, an Australian, has been A.O.C. Malaya since February 1955 and before that was for two-and-a-half years a Director of Operational Requirements at Air Ministry. He entered the R.A.F. College at Cranwell in 1928 and during the war won the D.F.C. in 1941 (for leading the No. 139 Sqn. attack with Blenheims on the Ijmuiden steel works) and the D.S.O. in 1945.

A.V-M. Kirkpatrick has been A.C.A.S. (Operational Requirements) at Air Ministry since February, 1957, and was for two years before that a Director of Operational Requirements. He joined the R.A.F. in 1932 from Oxford University Air Squadron and during most of the war served in Bomber Command, being awarded the D.F.C. in December 1941, when he was commanding No. 218 Sqn.

Battle of Britain Reunion

THIS year's Battle of Britain aircrew reunion will be held on Sunday, September 15, at 7.30 p.m. at the R.A.F. Club, 128 Piccadilly, London, W.1. All who are entitled to wear the Battle of Britain clasp to the 1939-45 Star are eligible and welcome to attend. Dress will be lounge suits, and tickets (31s including buffet and drinks) may be obtained from the Secretary, Battle of Britain Aircrew Reunion Committee, Ops A.D.4, Air Ministry, Whitehall Gardens, London, S.W.1. Prior to the reunion, at 6.30 p.m. at the R.A.F. Club, there will be a meeting to discuss the formation of a permanent Battle of Britain Aircrew Association.

IN BRIEF

The R.A.F.A. Motor Club's third annual Battle of Britain Rally will be held in North and Central Wales next weekend.

* * * * *

Fleet Air Arm, written by John W. R. Taylor and profusely illustrated with photographs and silhouettes, is a new addition to the ABC booklets published by Ian Allan, Ltd., Craven House, Hampton Court, Surrey, at 2s 6d.

* * * * *

This year's Britannia Shield competition—which commemorates, by a series of sporting contests, the spirit of the comrades-in-arms of different nations who took part in the Battle of Britain—will be held between September 30 and October 2.

From left to right, A.V-M. C. D. Candy, D.C.A.S. of the R.A.A.F., with A.V-M. E. C. Hudleston, who was visiting his native Australia before becoming V.C.A.S. (with the acting rank of air marshal) next month; and Sgt. R. Willimczyk, first naturalized Australian to be trained as a pilot in the R.A.A.F. since the war, given his wings by Vice Admiral Sir Roy Dowling, Chief of the Australian Naval Staff.

FOR FARNBOROUGH VISITORS

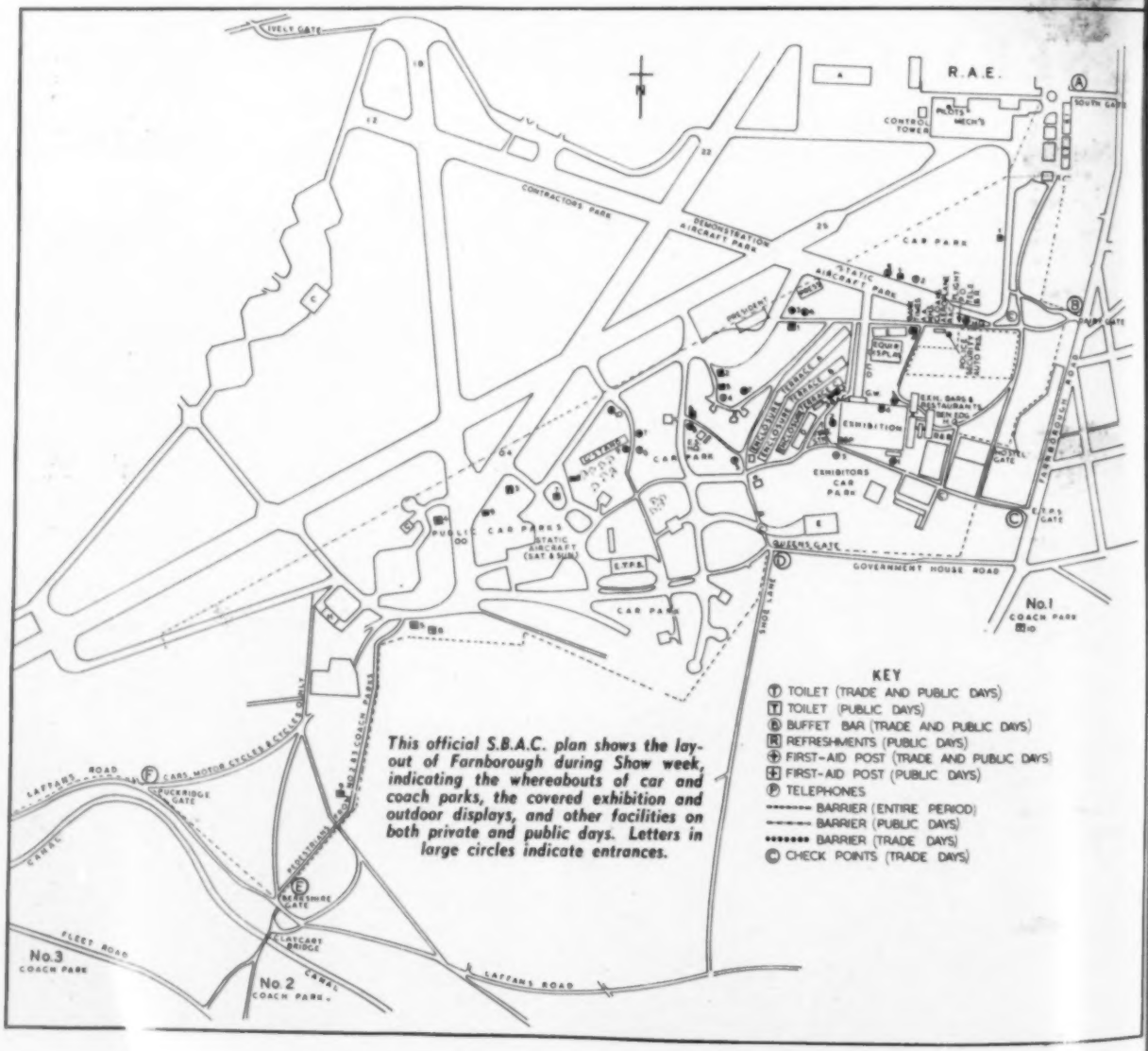
ROUTES, PRICES, TIMES, FACILITIES

FROM next Monday until Sunday, September 8, most roads and railways will lead to Farnborough, and whatever the visitor's mode of travel to the 18th S.B.A.C. Display there—whether by aircraft, car, coach, train, bicycle or on foot (though this last approach is not recommended, considering how much enforced walking has to be done at the show)—the following information should be of help. For though R. L. Stevenson said whimsically that it was better to travel hopefully than to arrive, he had never been to Farnborough; and the S.B.A.C., R.A.C., A.A., police, British Railways and bus companies participate not only to make the enthusiast's travel hopeful but also to see that he arrives.

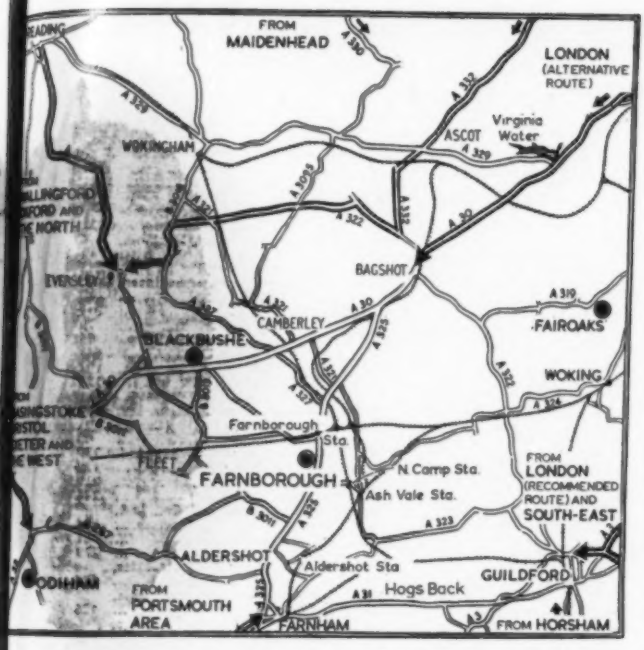
Starting early is a useful habit on most occasions, but the R.A.C. especially urge it on road-users going to Farnborough—particularly on the public days, Friday, Saturday and Sunday, September 6, 7 and 8—because of the exceptionally heavy traffic (though crack-of-dawn starters should remember that gates do not open until 10 a.m.). The Club further advises that official routes should be followed, and to expedite this has put up—in co-operation with the police—more than 600 temporary direction signs. The diagrammatic map on the page opposite indicates clearly the points (marked by arrows) where these signposted routes begin; and once under police-R.A.C. guidance, road-users will find navigation straightforward. From London, recommended routes are *via* Guildford or Bagshot; from the north, *via* Reading and the A 327; from the west, *via* the A 30 to Hook; and from the south, to Farnham *via* the A 31, A 325 or A 287 from Hindhead.

Not only does the R.A.C. direct road-users *en route*; with the A.A. it offers help if mechanical or other trouble occurs—through the agency of offices on the airfield which are in constant radio contact with vehicles patrolling the approach roads—and at the entrances to Farnborough a special force of patrolmen will direct cars, coaches and motor-cycles into appropriate parks.

Motorists and motor cyclists, of course, form only part of the annual pilgrimage to Farnborough; hundreds of other air-minded citizens journey there by public transport. For them, British Railways make available special rail-road cheap day tickets; put on excursions from different parts of the country; and run extra trains from Waterloo on the public days to supplement existing services. The rail-road facility is run in conjunction with the



This official S.B.A.C. plan shows the lay-out of Farnborough during Show week, indicating the whereabouts of car and coach parks, the covered exhibition and outdoor displays, and other facilities on both private and public days. Letters in large circles indicate entrances.



Road approaches to Farnborough airfield. From the points indicated by arrows, police-approved routes are sign-posted by the R.A.C.

Aldershot and District Traction Co., Ltd., whose buses meet passengers at Aldershot station and take them to the airfield. These rail-road tickets are available at a large number of booking offices. For those preferring to travel the whole way from London by coach, the Aldershot Traction Co. runs an hourly service from Victoria Coach Station from 8.50 a.m. onwards, the journey to a point within a few minutes' walk from the airfield taking 1 hr 35 min approximately. The fares are 4s 9d single; 6s 9d day return; and 8s for a period return. Seats may be pre-booked either at Victoria Coach Station or at travel agents. The rail-road fare from Waterloo—2nd class return—is 9s.

Guests of the S.B.A.C. who travel by air to the display on the private days or next Friday can also arrive at Farnborough by coach, which is provided to bring them from their landing point at Blackbushe. This coach commutes frequently between the two airfields (about once every half-hour during rush periods) and all that is required to board it is to show one's badge or ticket.

Admission and parking charges vary between the Friday and the other two public days. On the Friday they are: adults, 20s; children (under 14), 10s; private-car parking, 20s; motor coaches, 20s; motor cycles, 5s; bicycles, 2s 6d. (On each public day tickets can be obtained at the gates, but for the Friday—and Friday only—they may alternatively be purchased in advance from Auto Parks, Ltd., 1 Maclise Road, London, W.14, or through the usual agencies.) Prices on the Saturday and Sunday are: adults, 5s; children (under 14), 2s 6d; private-car parking (inclusive of up to six occupants), 30s; motor coaches, 10s; motor cycles, 2s 6d; bicycles, 1s.

On public days the flying display—subject, of course, to weather conditions—starts at 3 p.m. (It lasts for about two hours). There is thus ample time before it begins to take a look at the static aircraft and the equipment out of doors, and to visit the exhibition hall. The plan on the opposite page shows clearly the positions of everything at the airfield in relation to the entrances and car parks. It shows, too, where refreshments can be obtained and the whereabouts of facilities of all kinds, including a post office and bank, first-aid post and an inquiry office for train and bus times. Everything, in short, has been laid on to make the 1957 S.B.A.C. Show as successful as its seventeen predecessors; so if weather conditions are reasonable, the hopeful traveller will find his journey thoroughly worthwhile.

(Exhibition Hall stand numbers: page 376, overleaf)

THE M.o.S. CONTRIBUTION

EIGHT exhibits—five in the main exhibition tent and three in the covered equipment section—form the Ministry of Supply contribution to this year's S.B.A.C. display at Farnborough. Those in the main exhibition tent are: a new technique for measuring the optimum coolant-flow required for radio equipment in high-performance aircraft (developed by the Radio Department, R.A.E.); an integrated flight-instrument system to suit increased performance and space limitations in modern fighters (Instruments and Air Photography Dept., R.A.E.); self-contained Doppler navigation equipment (R.R.E., Malvern); a data transmission system to speed the sending of punched-card information over long distances (Trials Dept., R.A.E.); and a display showing the technique and results of work carried out at the National Gas Turbine Establishment, Pyestock, to improve gas turbine performance by raising inlet temperatures.

Exhibits on the M.o.S. stand in the covered equipment section will be a demonstration of guided-weapon homing using a 25ft G.P.V. in conjunction with a moving dummy target, displayed by the G.W. Dept., R.A.E., in conjunction with Elliott Bros. (London), Ltd., and Short Bros. and Harland, Ltd.; and two servo systems designed at the R.A.E., one showing the power amplification, smoothness and speed of response of a typical G.W. electro-hydraulic servo; the other a more powerful moving wing servo ring containing four 10 h.p. electro-hydraulic servos operating at oil pressures of up to 4,500 lb/sq in.

The need for data on radio equipment in high-performance aircraft, to enable designers to produce optimum conditions where satisfactory performance is achieved with a cooling supply of minimum weight and power, has led to the development of a special technique for measuring the optimum coolant flow required without over-running the temperature of the equipment on test. Components which temperature-indicating lacquers (applied before test) have shown to be approaching their limit temperatures are instrumented by thermocouples to an automatic recorder from which the critical component can be selected and the optimum coolant flow calculated from time-temperature curves.

The flight instrument system on display combines on five indicators the following information obtained from simulated inputs: I.A.S. and Mach number; barometric altitude and vertical speed; altitude with director indices; navigational display indicator comprising heading, desired heading, I.L.S. and Tacan range and bearing.

Work on Doppler systems started at the R.R.E. in 1946 and results were so encouraging that a contract was placed with Marconi's Wireless Telegraph Co., Ltd., for the development (in conjunction with the R.R.E.) of a Doppler equipment for the R.A.F. and this has now been in production and service for the past three years. The equipment is self-contained and gives an aircraft its position without the assistance of ground stations.

A transmission system for sending punched-card data over long distances will be in use on the M.o.S. stand to receive information from guided weapons trials at Aberporth for calculation on the Deuce computer at Farnborough.

The N.G.T.E. will be showing some of its experimental work to raise the inlet temperatures of gas turbines (at present not normally exceeding 1,150 deg K in uncooled engines at cruise conditions) so as to enhance their performance. In these studies direct cooling of the blades, by air tapped from the compressor exit, has been favoured because of its mechanical simplicity.

A demonstration of recent G.W. research will show how a homing guidance system enables a guided weapon to close with an aircraft in flight. (The G.P.V. on view is one of a current sequence of flight rounds and will shortly be fired at Aberporth.)

An actuator installation included in the servo demonstration is for the G.P.V. shown in the adjoining "homing" display; its installation was carried out by H. M. Hobson, Ltd., in conjunction with Short Brothers and Harland, Ltd., under M.o.S. contract. Also in the covered equipment section is a C.T.V.5 moving wing servo ring, typical of equipment designed and manufactured by R.A.E. for use as a research tool in a test vehicle.

"FLIGHT" PHOTOGRAPHS

MANY of the photographs reproduced in *Flight*, i.e., those taken by our own photographic staff (as indicated on publication) are subsequently available in the form of high-quality prints. Prices are as follows (dimensions given in inches): $5\frac{1}{2} \times 3\frac{1}{2}$, 1s 4d (glossy or semi-matt, unmounted), or 2s (toned sepia, unmounted); 6×4, 2s 6d or 4s; 8×6, 3s 6d or 5s 6d; 10×8, 5s or 7s 10d; 12×10, 6s or 9s 8d; 15×12, 9s 6d or 13s; 20×16 (semi-matt only), 13s or 18s.

Also available are a postcard series, totalling over 200, depicting both historic and modern aircraft of the R.F.C., R.N.A.S., R.A.F. and Fleet Air Arm. A list is obtainable on application. Prices are 8d each card, or $7\frac{1}{2}$d each for a dozen or more.

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Hawker Siddeley Group ... E
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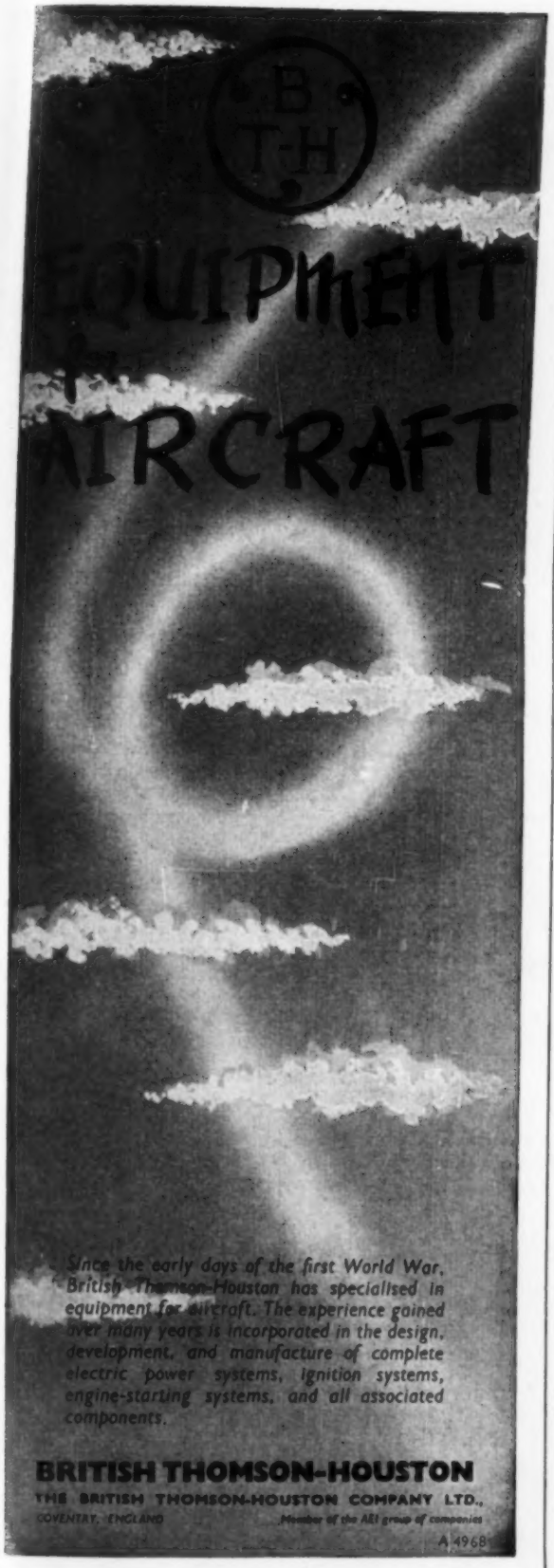
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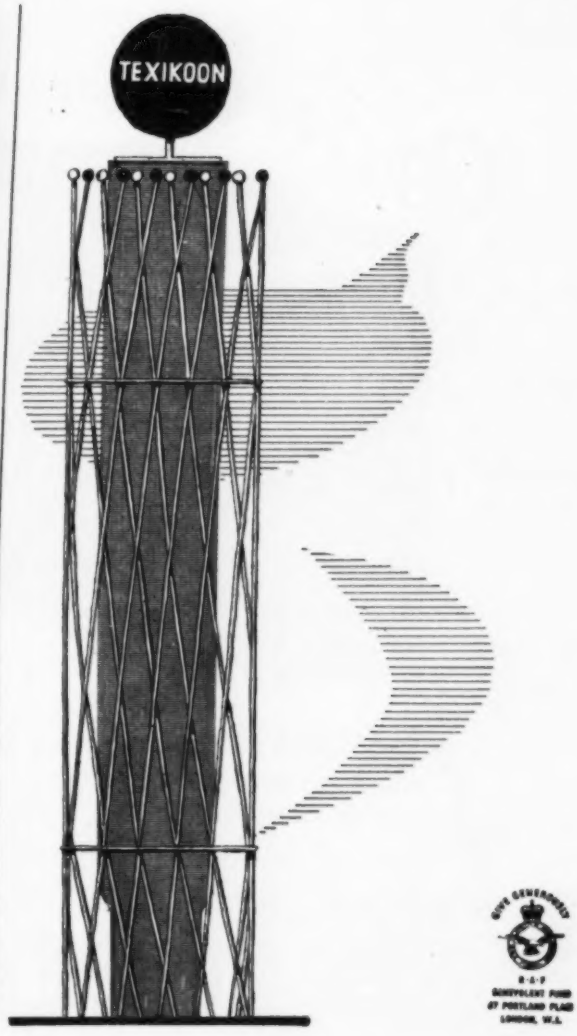

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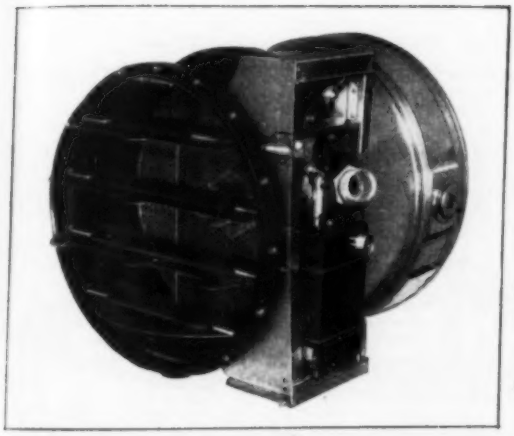

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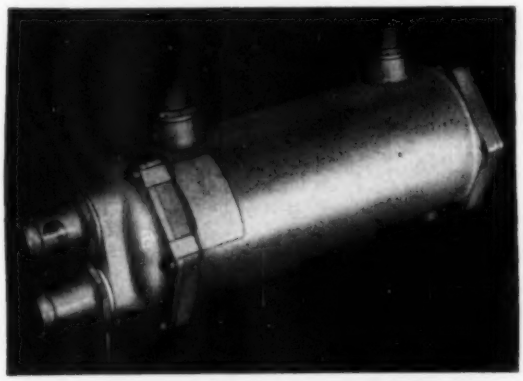

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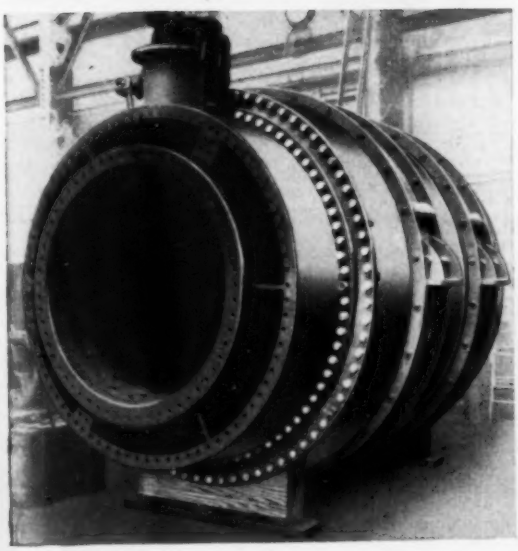

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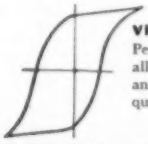

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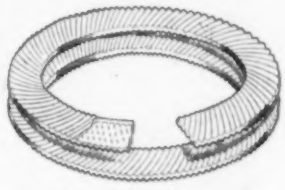
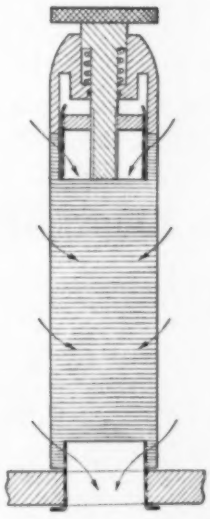


Cutaway section through plastic disc



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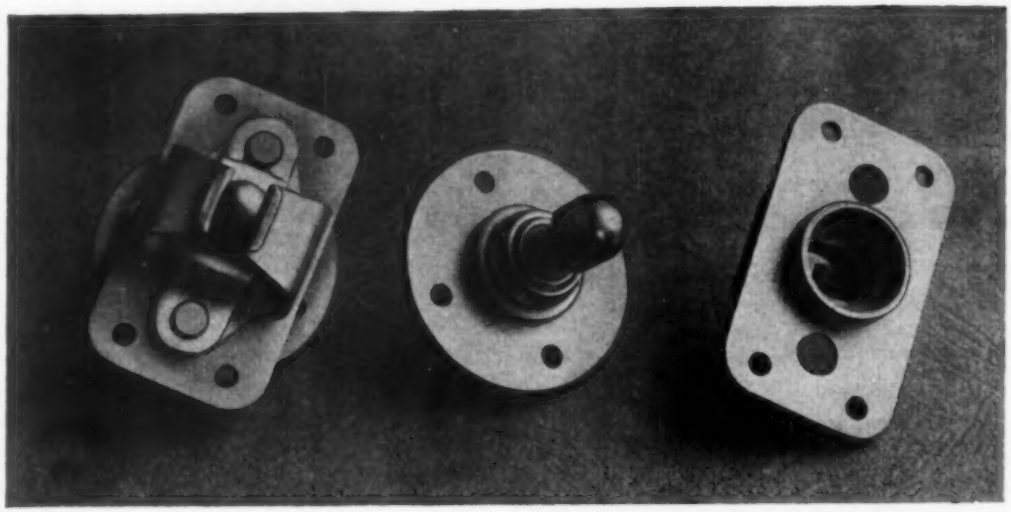

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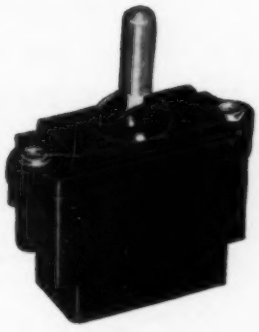

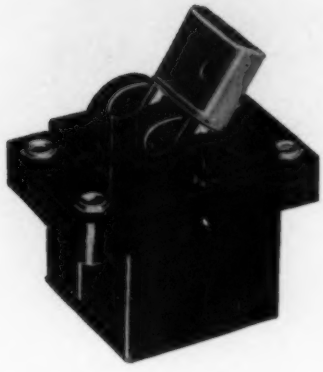

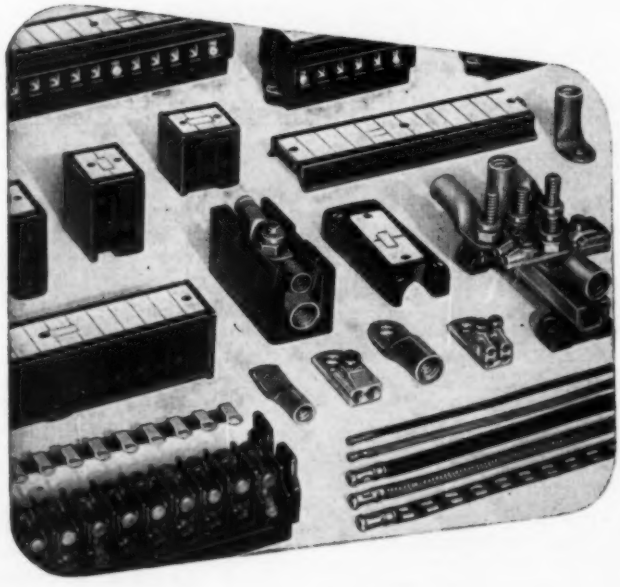

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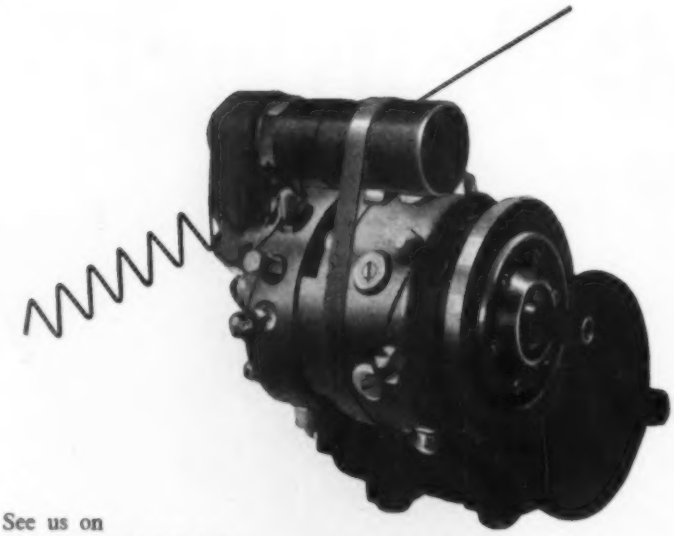

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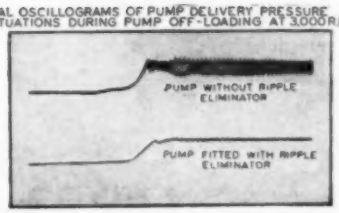

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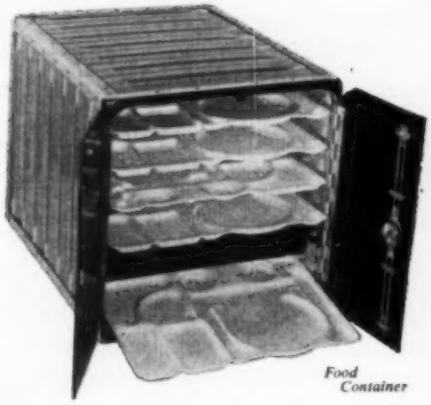

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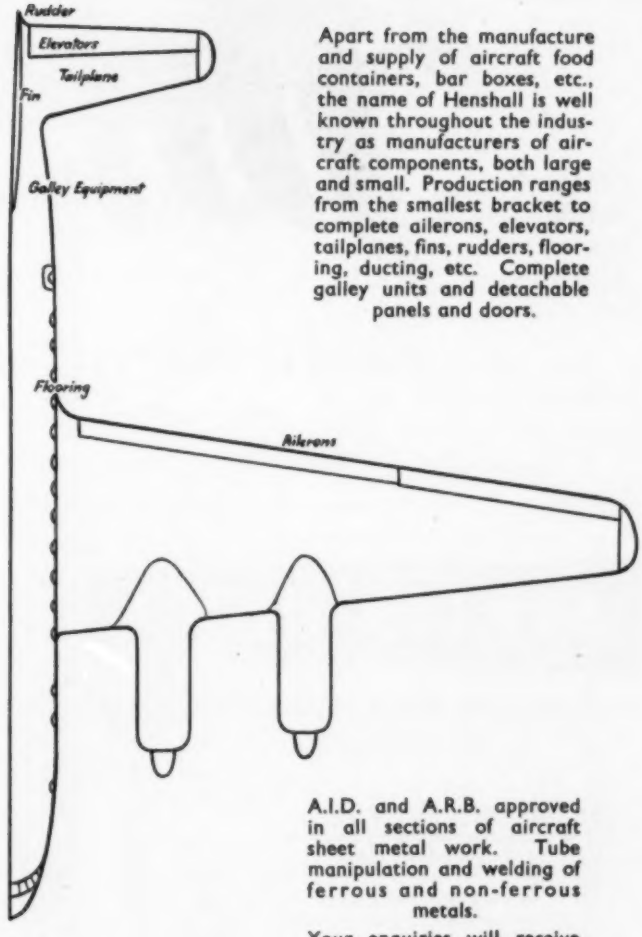

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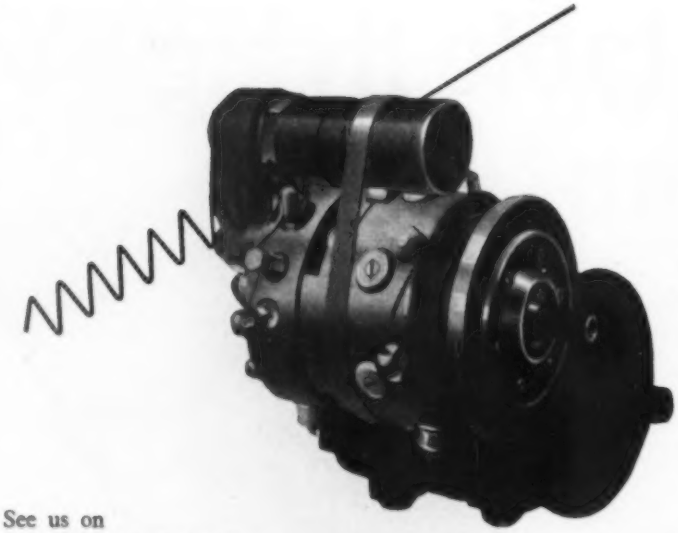

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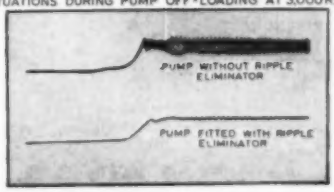

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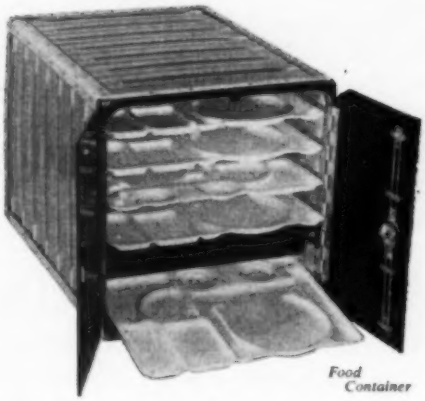

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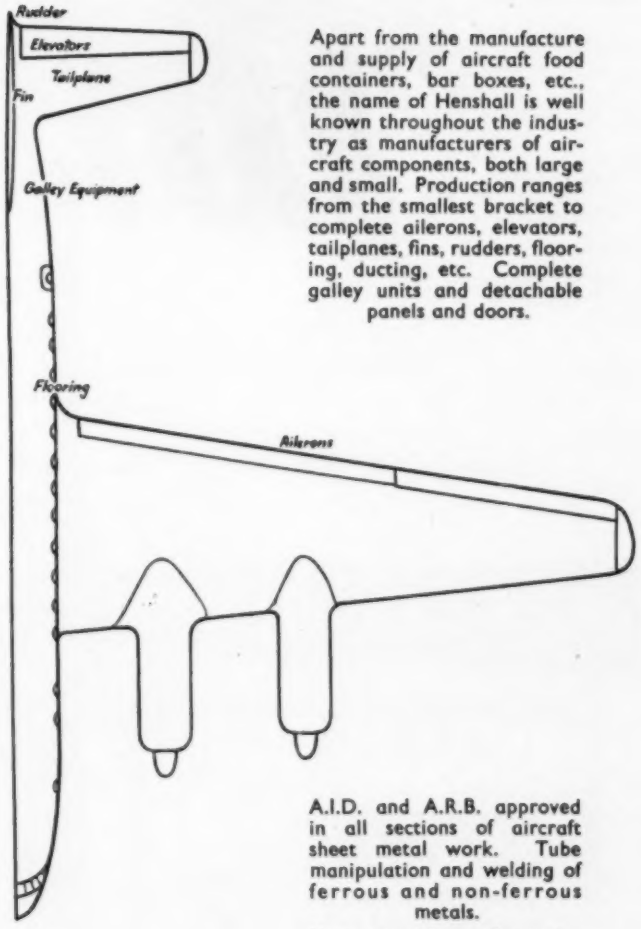

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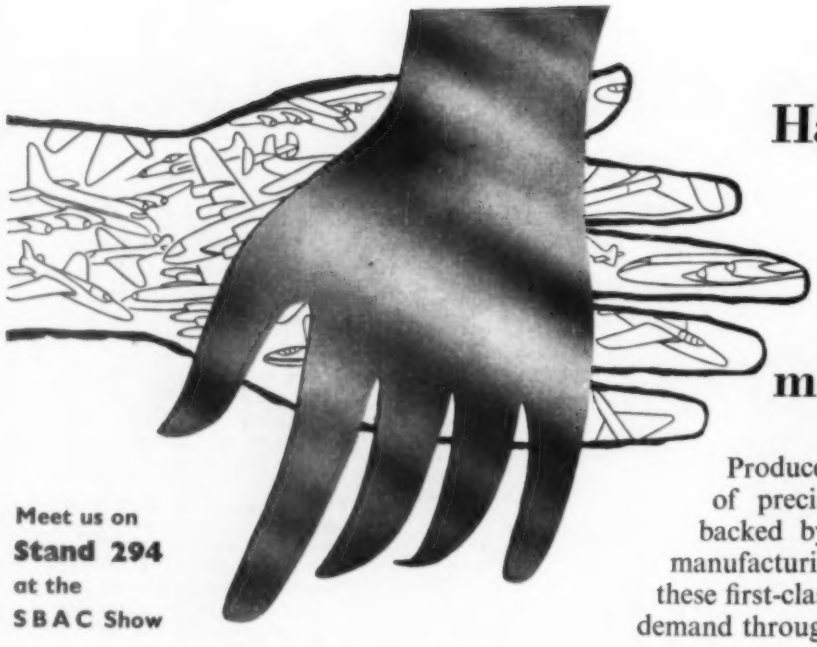

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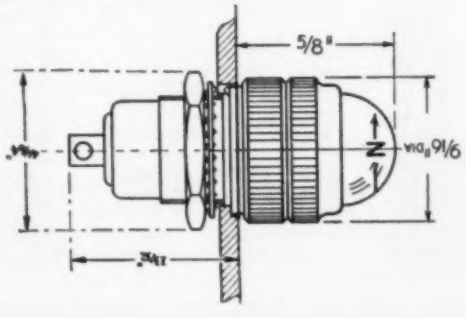

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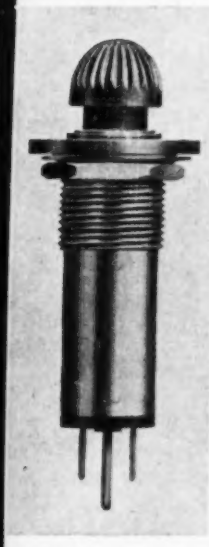

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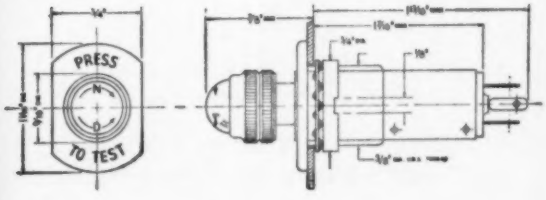

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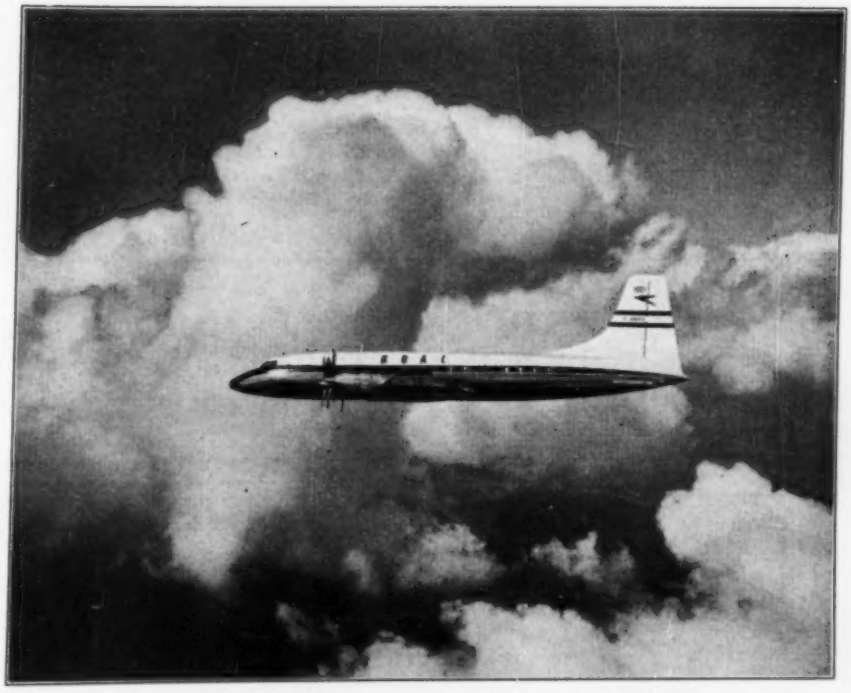

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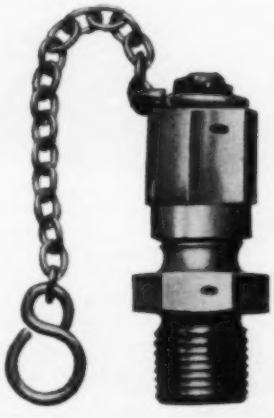

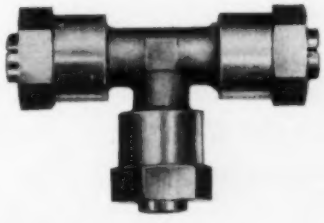

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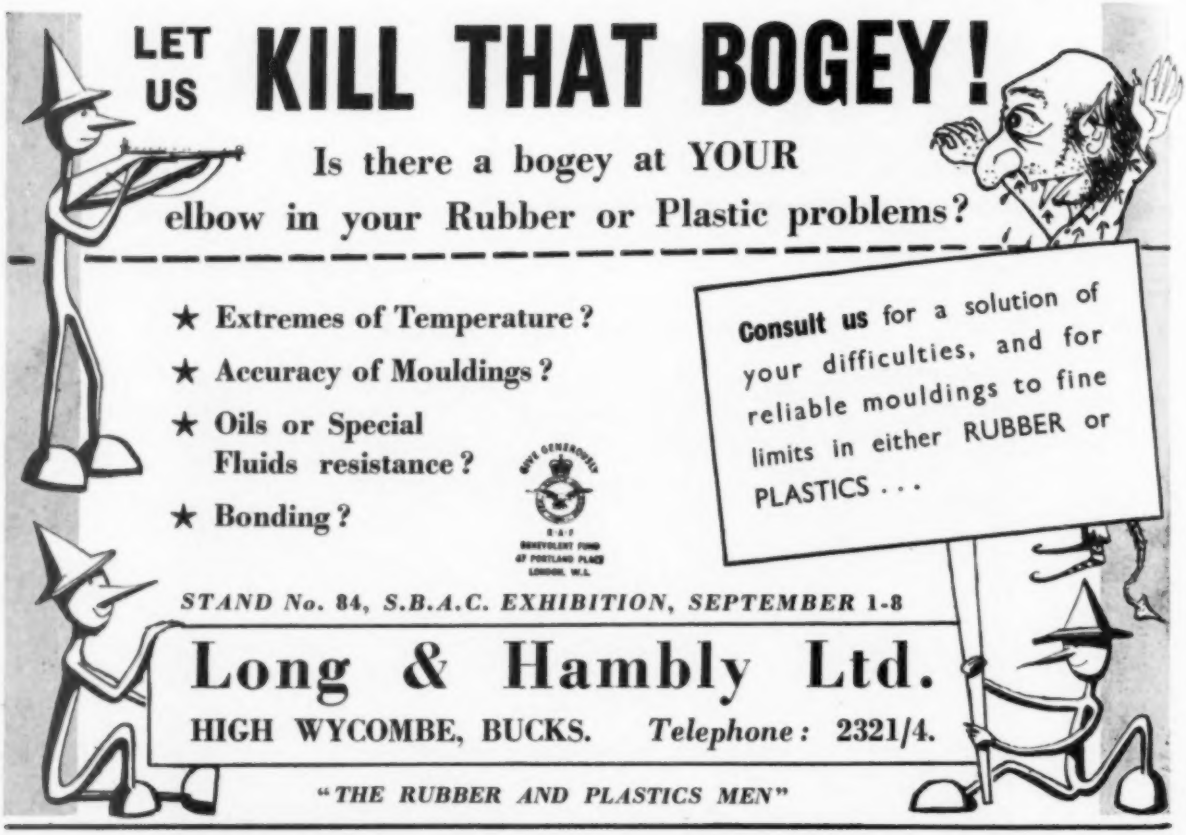
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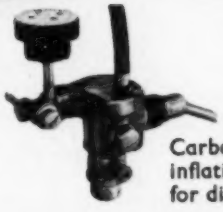

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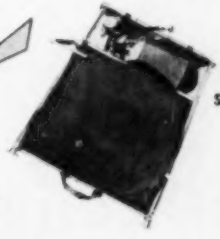

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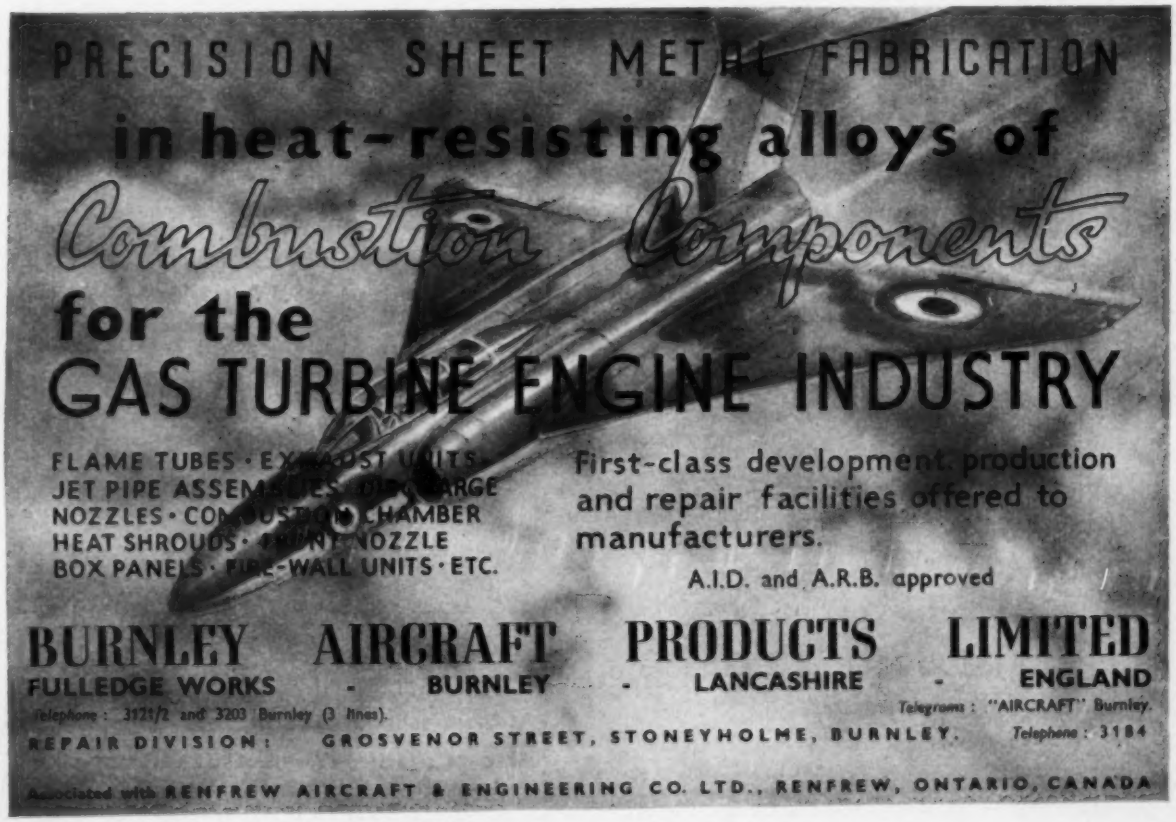
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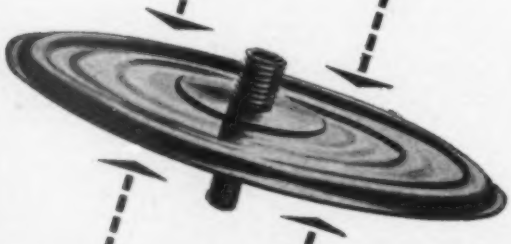

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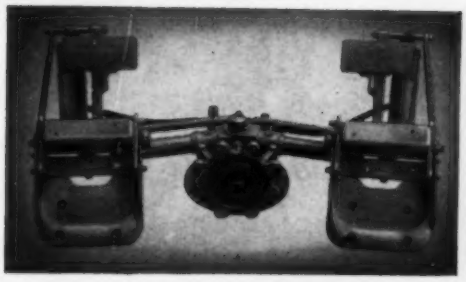

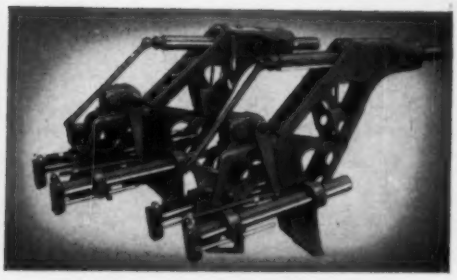

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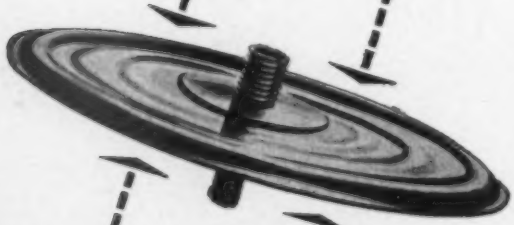

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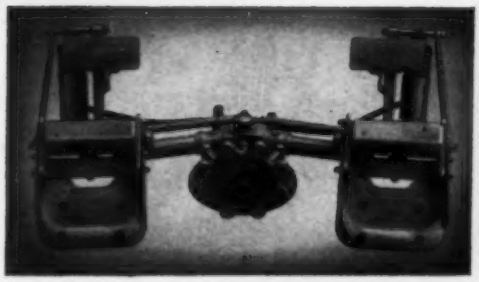

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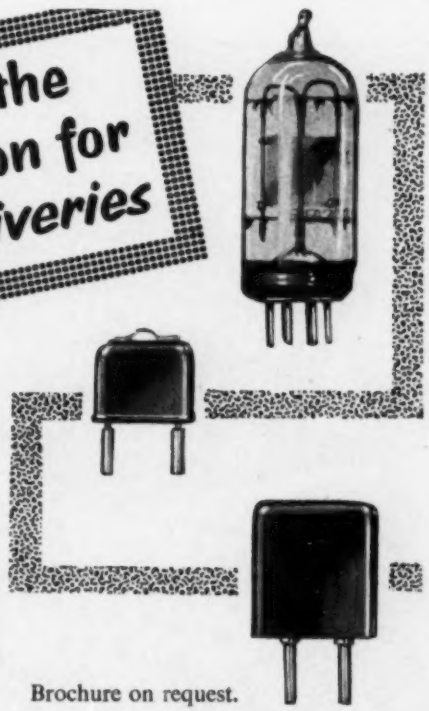

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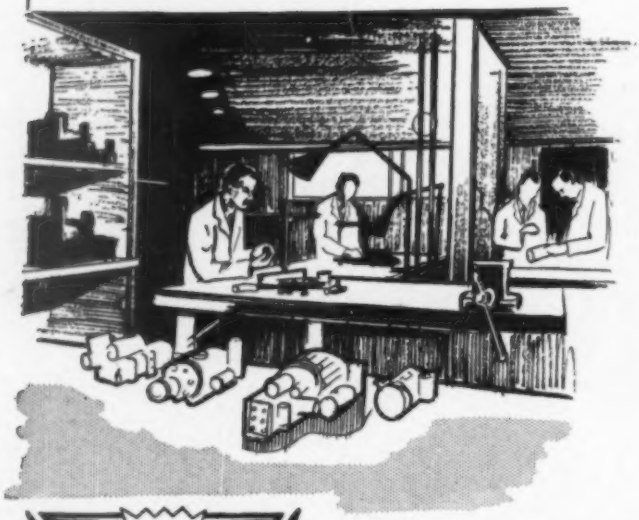

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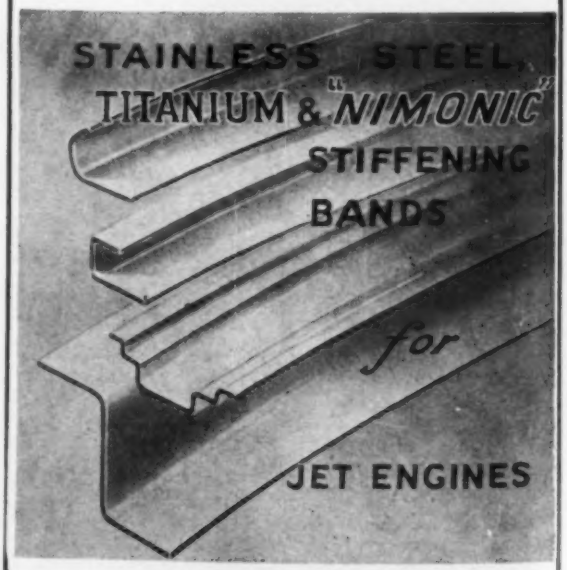

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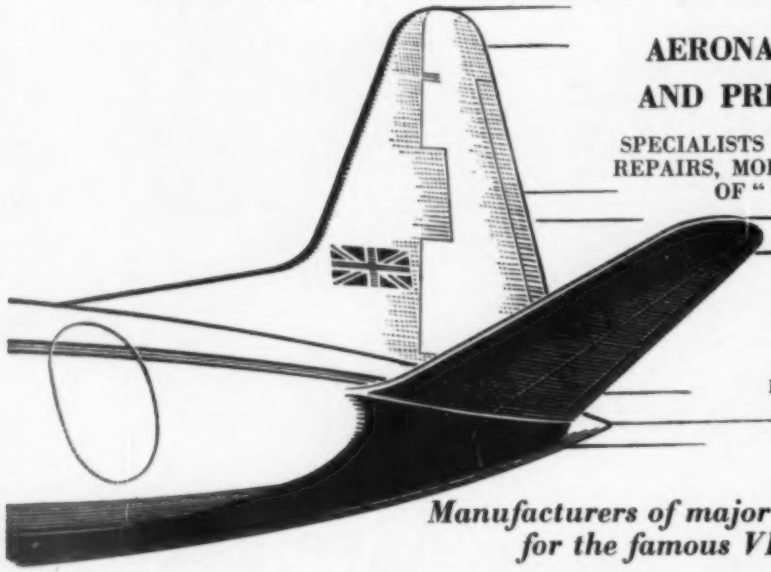

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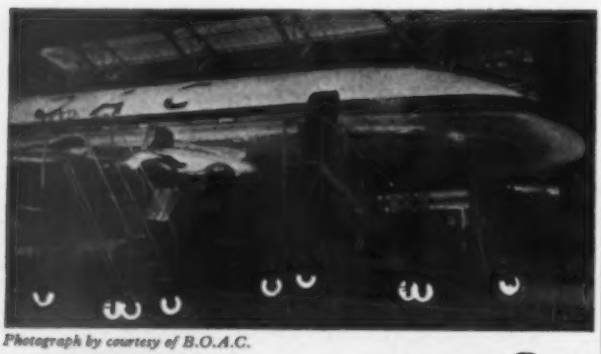

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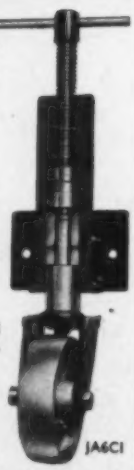

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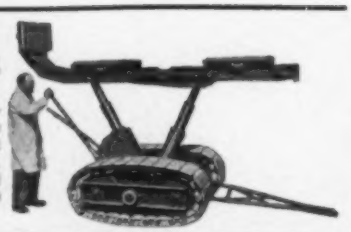

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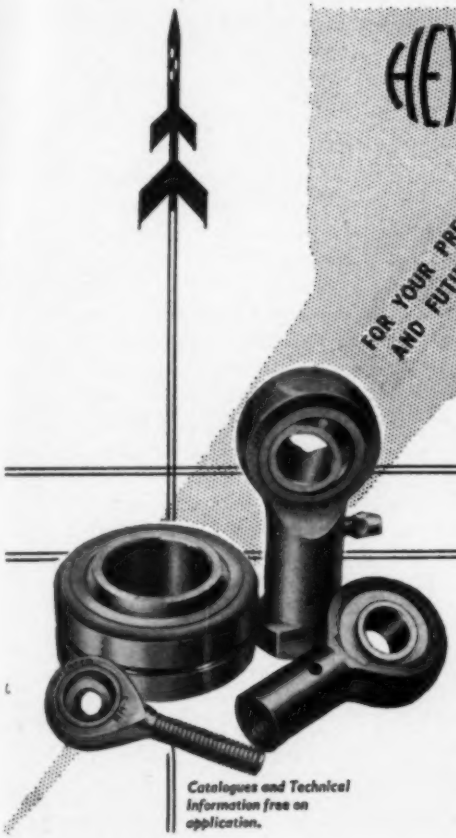

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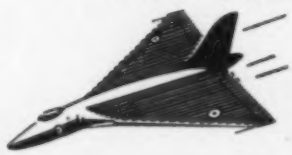

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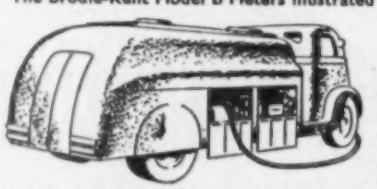

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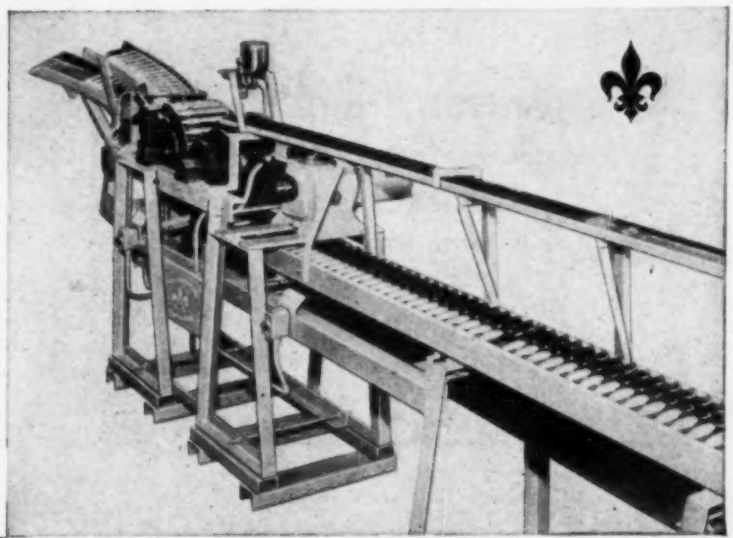

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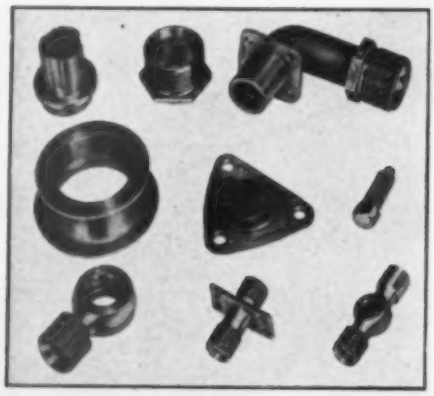

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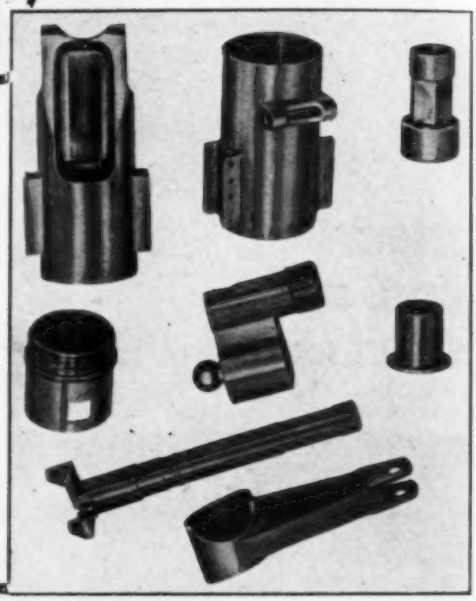

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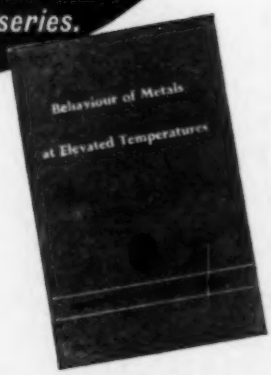

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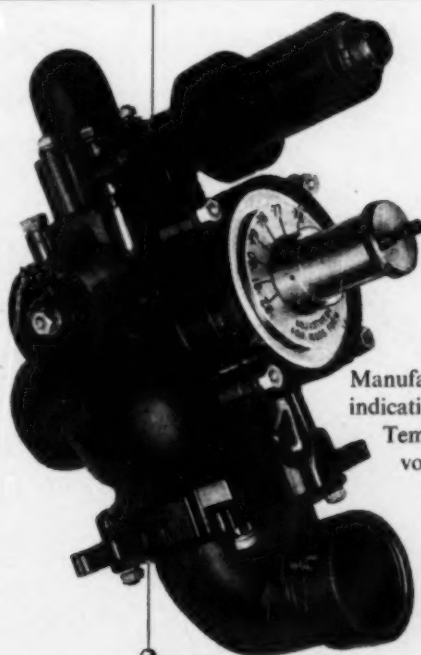

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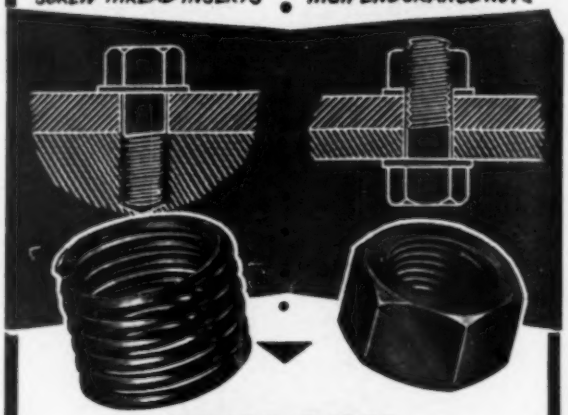

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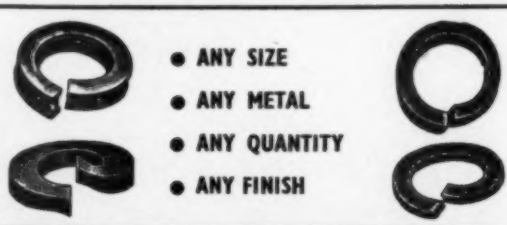

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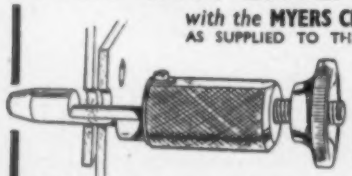

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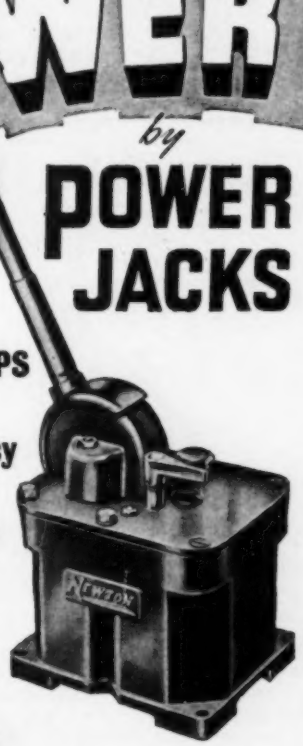

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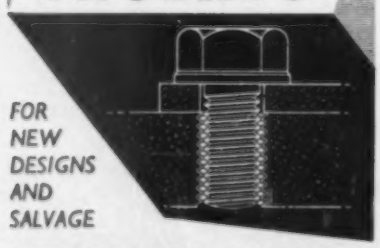

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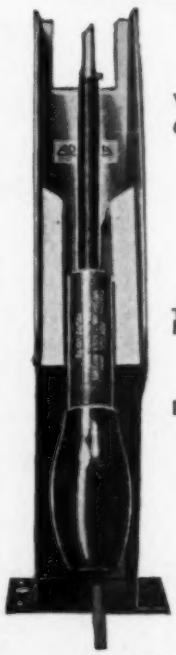

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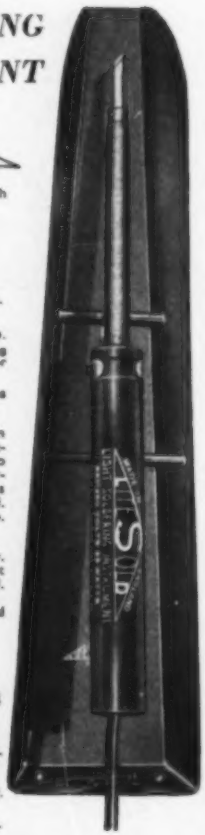

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SCIENTIFIC OFFICERS

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FURTHER particulars, from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting No. S.53/57 for Senior Scientific Officers and S.52/57 for Scientific Officers.

INTERVIEW boards will sit at intervals, as required. Early application is advised. [6998

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INTERVIEW boards will sit at intervals, as required. Early application is advised. [6997

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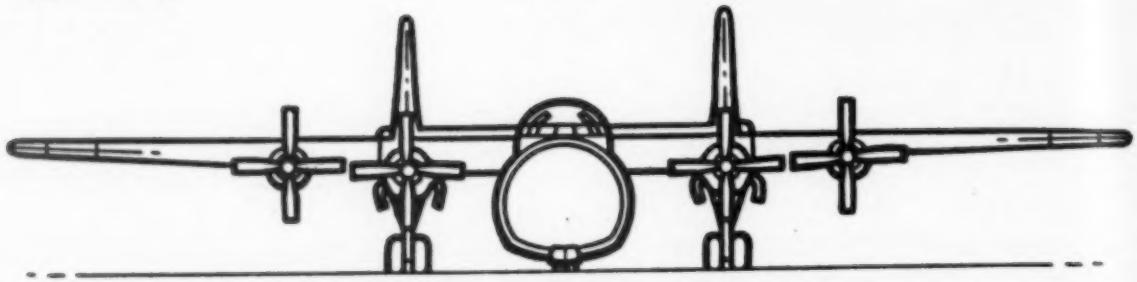

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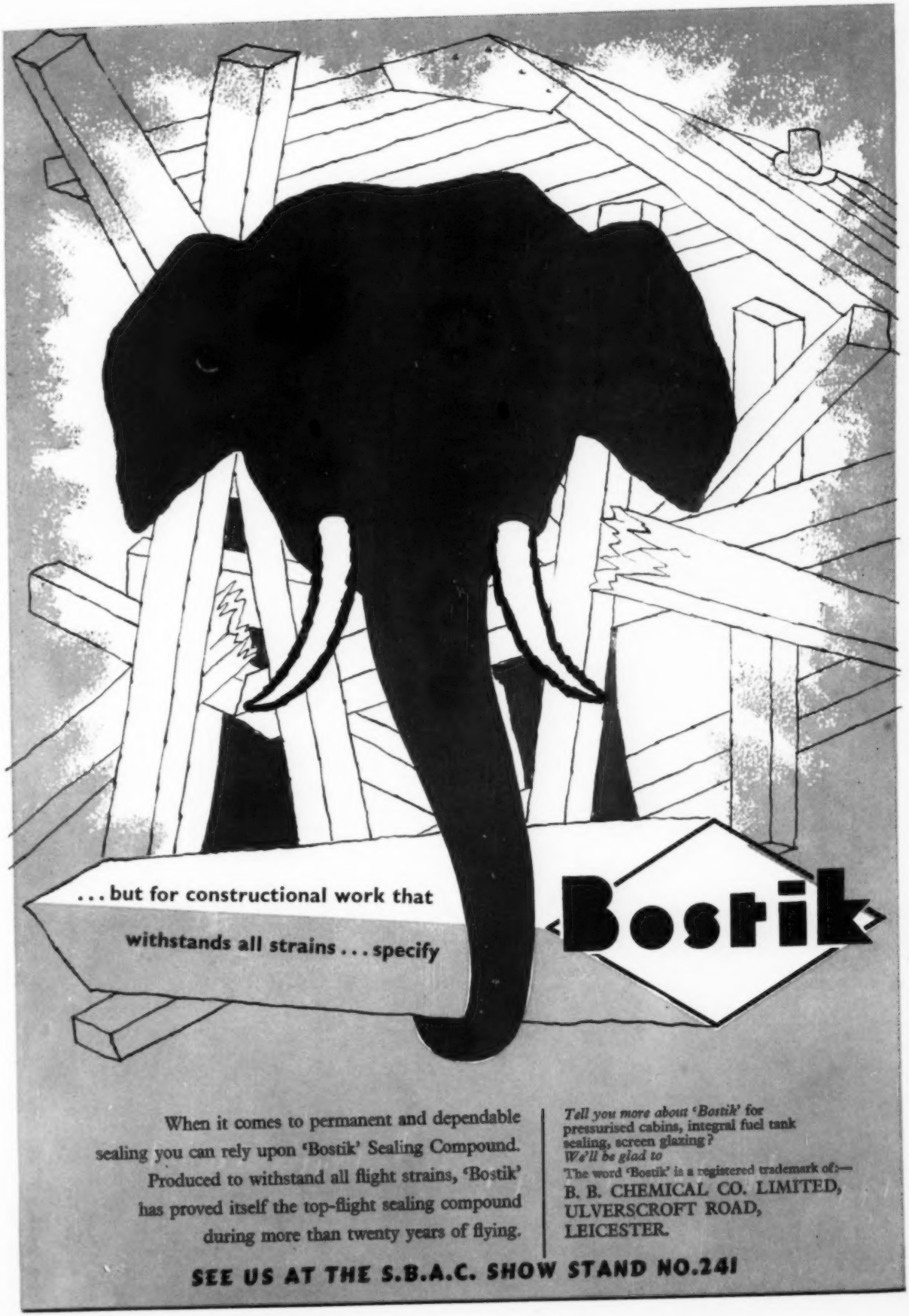

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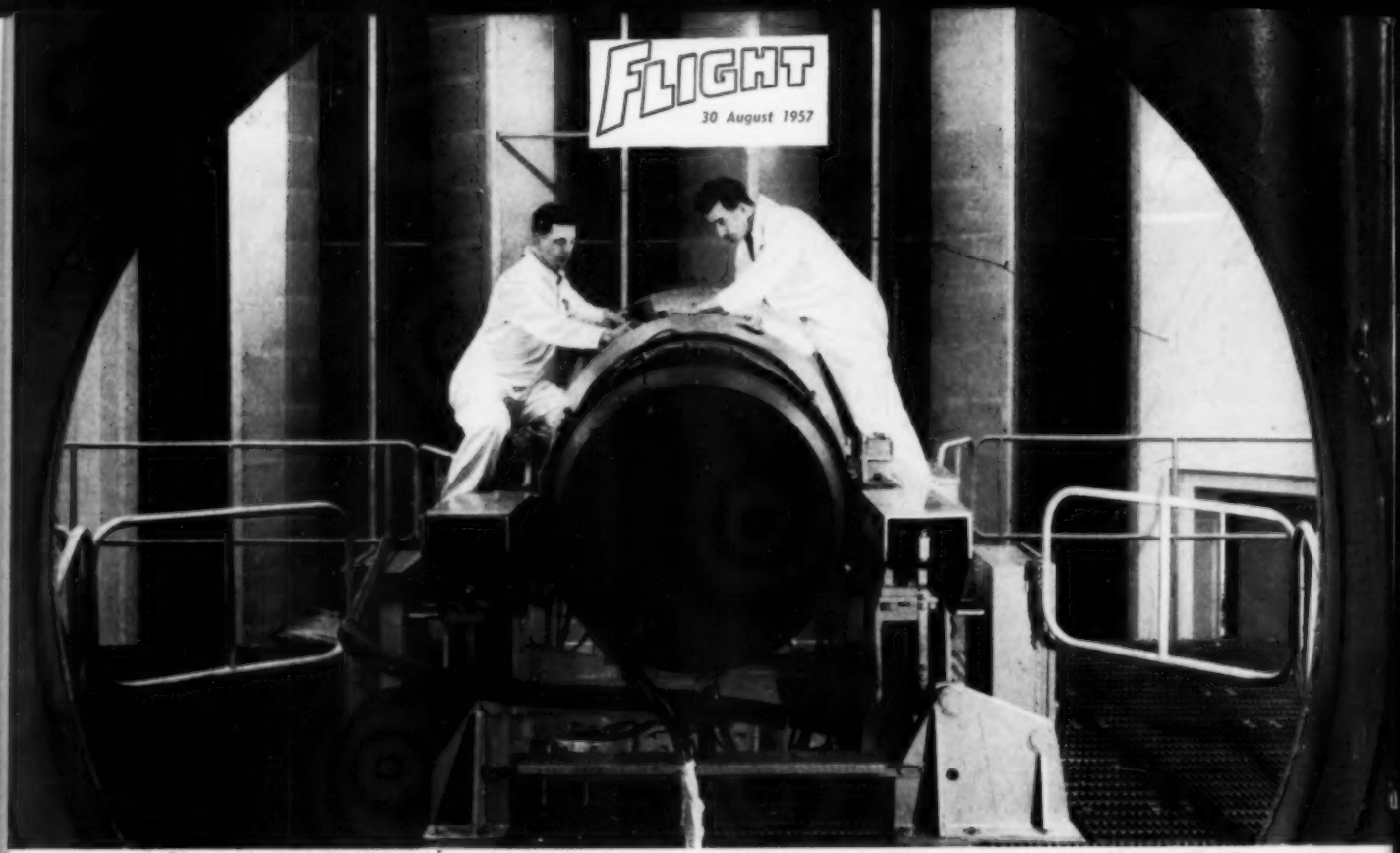

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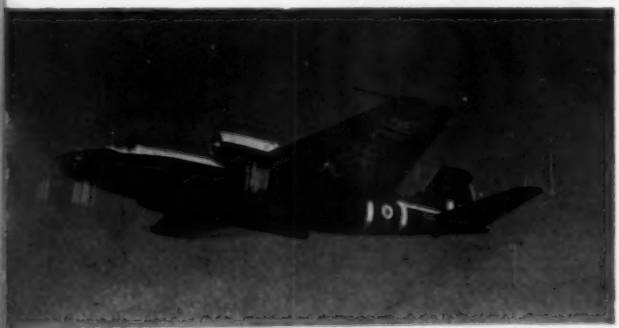

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